POWER

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PHILIP W. SWAIN, Editor

ELBOW GREASE

SPRING is in the air and the time has come to clean house—in home, factory and cranium.

● The job has already started, almost everywhere, because 125,000,000 Americans are bored stiff with individual inaction, with waiting for it all to "blow over."

● Waiting for this and that has grown tiresome. We waited for the last election and it turned out as all skilled predictors had predicted. Next we had to find out about "that there" gold clause. Again—by narrow squeak—the major predictors were right. And, if they had not been, Congress had strong medicine ready to revive the patient after his tooth was pulled.

● Now we sit and watch to see what Congress will do about social security legislation. Or, rather, we move about our jobs and watch a little, because we know that Washington will do something and have a general idea of what it will be. We shall get old-age pensions, probably on a sound "paid-for" basis—a fine thing for men, morale and probably business as well, although some can't see it.

● We may muddle through into some sort of unemployment insurance scheme, probably half-baked, because this is a matter on which there are a thousand opinions, mostly wrong. Major mistakes, we expect, will be rectified before they kill the patient or the doctor.

● With a few exceptions we can be pretty sure what Congress will do on almost every other major question.

● Therefore, except for the diversion of watching the news bulletins fulfill the predictions, there isn't much to do these days except to mind one's own business, which should be a lot of fun for a change.

● The first step in business minding, after a long siesta, is house-cleaning from top to bottom. First, policy-product house-cleaning—new studies of markets, products, sales methods. Development of new products to meet the irrepressible consumer demand for something better looking, more productive, easier to operate, more efficient, cheaper to maintain.

● Physical cleaning of plant and equipment—soapsuds, waste, kerosene, elbow grease, paint. Replacing obsolete equipment, wherever old-fashioned logic, plus modern facts, indicates a handsome profit on the change.

● Mental house-cleaning—chucking obsolete notions (whether vintage 1934 or 1928) out the window for those that will stand the gaff of today and tomorrow.

● If this cleaning job is done right, all else will follow as a matter of course. The American habit of getting things done will not be denied much longer, if we once more sense the thrill of seeing the dirt fly. Public spirit today is best expressed through private action. That private action brings its own immediate and undiluted reward.

PRESSURE

NO BETTER illustration of power progress can be found than the growing use of high steam pressures in industry. Ten years ago, high pressures sounded logical for the process plant. Today they are typical.

Just consider the industrial steam plants, operating at 300 lb. and up, described in *Power* during the past six months: Clinton Cotton Mills, 400 lb.; Bayway Refinery, 650 lb.; Hamm Brewery, 300 lb.; Fort Howard Paper, 420 lb.; Firestone Tire & Rubber, 1400 lb.; Ford, 1400 lb.; W. Va. Pulp & Paper, 600 lb.

The new power ideas of today are now meeting their first test, ability to stand analysis. In another five years, many of these will join high-pressure steam as accepted power practice.

HANDBOOK OF MAINTENANCE

FEBRUARY *Power* presented something new, a boiled-down handbook of modern piping practice, nine articles on the subject in thirteen pages.

This was merely the start of a plan which will be applied several times during 1935. Watch next for April *Power* with 20 pages on Maintenance. Designed throughout for practical men, the 12 articles will cover every phase of this work from the general planning and recording system through to detailed instructions for the maintenance of boilers, motors, transmissions, pumps and other service equipment.

Another condensed handbook of modern practice—the second of five to be presented during 1935. What do you think of the idea? Any suggestions?

FUTURE OF POWER MEN

IN ALL the present hullabaloo about different systems of power generation and various schemes of ownership, certain fundamentals are generally overlooked. These are simple: Industry, buildings, cities and homes will demand power in constantly increasing amounts.

More equipment and more complex equipment will be needed to generate and use this power. There will be more jobs and better jobs for power engineers—for those who can keep in step with modern developments, who are not afraid of high steam pressures, diesel engines, air conditioning, welding, new heat balances, electronic tubes, or of those still unknown power devices that tomorrow will place in their hands.

DIESEL VS. AIR CONDITIONING

A READER writes in, expressing a desire to branch out, and get ahead through study. Good idea—the engineer who has "completed" his education is headed for stagnation; the procession will leave him behind.

This operator sees both air conditioning and diesel engineering moving ahead, promising much for the future. He asks which to study. We don't know; both are good bets—about equally good. On the theory that too much specialization is risky, we suggest that this man and others of like mind study both.

This is better insurance for an unpredictable future; chances are that most power engineers will need to know both subjects before long. Incidentally, it is more fun to study two things than one.

OLD AGE PENSIONS

TOWNSEND proposed paying $200 per month to all men and women over 60. Economic nonsense, but appealing enough to get millions of supporters! Behind this foolishness lies one sound idea—the wisdom of providing for old age security. It is unlikely that the public demand for it will, or can be, denied.

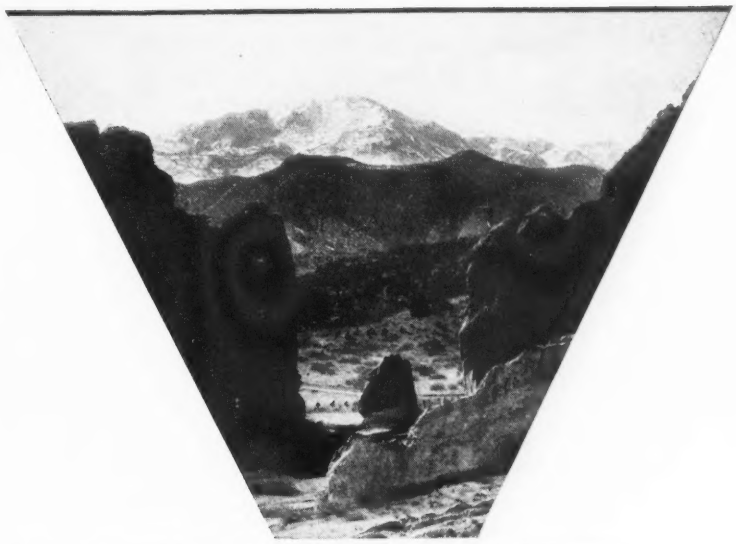
The Social Security Bill, now before Congress, has in its old-age-pension section a more practical aim, a modest pension starting at 65, paid from deposits automatically deducted from each pay check with an equal compulsory contribution from the employer.

This gets away from charity, although relief must continue for those already old. It preserves self-respect, enforces minimum savings for old age, takes some of the sting out of unkind fate and youthful heedlessness, says goodbye to the fairyland figures of the Townsend plan. It backs the insurance set-up with the credit of a whole nation, puts no restriction on shift of job or of residence, avoids unfair cost burdens on more humane employers.

Because of its many weak spots and danger points, *Power* is not yet ready to support the unemployment section of the Social Security bill. The present old-age provisions, however, are worthy of support.

POWER STANDS FOR

1. Making power when it should be made
2. Buying power when it should be bought
3. Cheaper power through modern equipment
4. Easier financing of equipment purchases
5. Better use of by-product heat and power
6. Operating methods that save money
7. Less waste in transmission and application
8. Prevention of smoke, within reason



In the shadow of Pike's Peak, the City of Colorado Springs installs an electrical control system in its municipal plant

TO MAKE GAS FIRING SAFE

CITY of Colorado Springs, Colo., has operated its own light and power department very successfully since 1925. In 1924, the franchise on the 2,250-kw. Manitou hydro-electric plant expired, and the plant, formerly operated by a utility company on the city's water system, reverted to the city without cost. The city then decided to operate its own light and power department and added a 1,250-kw. hydro plant. It also built a steam plant which included two 2,500-kw. turbine-generators and three 3,700-sq.ft. boilers supplying steam at 350 lb. gage and 550 deg. F. total temperature.

By the winter of 1931-32, power load had increased until peak demand exceeded steam-plant capacity by 60 per cent. This placed the city in an unsafe position in case of failure of either its hydro plants or transmission line, and led to a decision to add a new boiler and 5,000-kw. turbine to the steam plant.

For the new unit, 400-lb. gage throttle pressure and 750-deg. temperature were selected. Boiler heating area is 6,110 sq.ft. and maximum steaming capacity 65,000 lb. per hr. Boiler and steel-encased refractory setting are supported on a steel structure entirely separate from the building steel. The boiler is fired under the high side by five gas burners with a capacity of 120,000 cu.ft. of natural gas per hr. at 12.9 lb. abs. In event of gas failure, burners can be converted for oil firing in a few minutes. For this possible emergency, a supply of very thin oil (so it can be fired irrespective of outside temperature) is stored.

The boiler is equipped with an air heater that increases combustion-air temperature to 475 deg. Draft is provided by induced- and forced-draft fans driven by single-speed squirrel-cage motors through hydraulic couplings, the stack itself being practically only a vent. Fan speed is controlled by varying the amount of fluid (oil) in the coupling. Fan speed range can be varied from about 20 to 98 per cent of motor speed.

Gas is delivered to the plant at 40 lb. gage and is reduced to 25 lb. through a reducing valve to the boiler-house main. Another valve reduces pressure to 10 lb. at the boiler control valve, which controls the gas flow to five burners, Fig. 4.

A feature of the gas-burning equipment is the system to prevent improper starting and explosions in the furnace. Such explosions are not uncommon with gas, oil or pulverized coal and are sometimes accompanied by serious consequences.

In Fig. 4, the main control valve is electrically operated and is interlocked with the induced-draft fan. When the fan is in operation the valve is electrically latched to its operating mechanism by potential from the motor terminals. If the valve is open and power fails, it is released and closes. This makes sure that the fan will be started before the main gas valve is reopened. It is practice at this plant to run forced- and induced-draft fans for five minutes before starting the fire. This scavenges the furnace of all traces of gas.

As shown in Figs. 2 and 4, there are two valves in the connection to each burner, one hand and one electrically operated. The electrically operated valve is held open by a torque motor, and when released is closed automatically by a spring. It is interlocked with the hand-operated valve so that the latter must be closed before its burner can be started.

Each of the five burners has its own independent starting and protective system and control station. The latter comprises a mechanically-timed ignition switch, a control switch for the electrically operated gas valve, and a pilot light. Electrical connections for one burner are diagrammed in Fig. 5. Assume the draft fans are running, the furnace scavenged and the burner hand-operated valves have been closed. The process of starting a fire is as follows:

The gas-main electrically operated valve is opened until it can be regulated by automatic control, but is left on manual control. Then, the main pushbutton switch, Fig. 5, is closed. This completes a circuit

PRINCIPAL POWER EQUIPMENT
City of Colorado Springs, Colo.

Boiler and Auxiliaries

Boiler ..... Springfield Boiler Co.
Heating surface, sq.ft. 6,110; max. steaming capacity, lb. per hr., 65,000; gage pressure at boiler, lb. per sq.in., 410; total steam temperature, 750 deg. F.; furnace volume, 3,950 cu.ft.; max. B.t.u. liberated per cu.ft. per hr., 26,000.
Superheater, heating surface, 1,330 sq.ft.... Superheater Co.
Air heater, heating surface, 9,880 sq.ft.; air temperature leaving air heater, 475 deg. F.; gas temperature leaving air heater, 260 deg. F.
Breeching and stack..... Stearns Rogers Mfg. Co.
Refractories ..... Denver Fire Clay Co.
Boiler setting ..... Pickett & Gill
Water column ..... Diamond Power Specialty Corp.
Excess pressure regulator..... Bailey Meter Co.
Feedwater regulator ..... Bailey Meter Co.
Safety valves..... Consolidated Ashcroft-Hancock Co.
Non-return valve ..... Elliott Co.
Blowoff valves ..... Edwards Valve & Mfg. Co.
Automatic combustion control..... Bailey Meter Co.
Gas burners ..... Babcock & Wilcox Co.
Gas-burner safety and ignition system, Minneapolis-Honeywell Regulator Co.
Boiler gas-pressure regulator..... Fisher Governor Co.
Gas-main pressure regulator..... Bailey Meter Co.
Forced- and induced-draft fans.... American Blower Corp.
Hydraulic couplings on draft fans. Hydraulic Coupling Corp.
Fans driven by Westinghouse squirrel-cage motor
Feedwater heater, 75,000 lb. per hr.... Ross Heater Mfg. Co.
Feedwater automatic-temperature control, Powers Regulator Co.
Feedwater treatment ..... Am. Sand Banum Co., Inc.
Boiler feed pumps, 2; 10-stage; 1 turbine; 1 motor-driven ..... Allis-Chalmers Mfg. Co.

Turbine

Turbine-generator, 5,000 kw.; 0.80 p.f., 3,600 r.p.m.; 6,900 volts ..... General Electric Co.
Turbine bled at two points for feedwater heating
Automatic control of H.-P. bleed.... Powers Regulator Co.
Condenser ..... Ross Heater Mfg. Co.
Deaerating hotwell ..... Ross Heater Mfg. Co.
Circulating pump ..... Allis-Chalmers Mfg. Co.
Hotwell pump ..... Pennsylvania Pump & Comp. Co.
Steam ejector vacuum pump..... Ross Heater Mfg. Co.
Non-return valves on turbine bleed lines, Schutte & Koerting Co.

Piping, Valves, Meters

Atmospheric-relief valve ..... Atwood & Morrill Co.
High-pressure valves ..... Edwards Valve & Mfg. Co.
High-pressure valves..... Reading, Pratt & Cady Co.
Low-pressure valves ..... Reading, Pratt & Cady Co.
Traps ..... Fisher Governor Co.
Piping..... Midwest Piping & Supply Co.
Pipe covering and heat insulation.... Eagle Picher Lead Co.
Boiler-meter board ..... Bailey Meter Co.
Gas-flow air-flow meter ..... Bailey Meter Co.
Steam-flow, pressure and temp. recorder.. Bailey Meter Co.
Recording thermometer ..... Bailey Meter Co.
Thermometers ..... Taylor Instrument Co.'s
Draft gages ..... Bailey Meter Co.
Indicating gas-pressure gages..... Federal Gage Co.
Master pressure gage... Consolidated Ashcroft-Hancock Co.
Condensate tester..... Leeds & Northrup Co.
Nofuse switches on auxiliary power and light circuits, Westinghouse Elec. & Mfg. Co.

through the relay-transformer primary. Red pilot lights glow and show that circuits are alive but that the burner is not in service. One part of the transformer secondary connects to relay coil No. 2 and the Protectoglow, the other part energizes relay coil No. 1. Relay-coil No. 1 circuit is through the gas-valve interlock button, 2*A* contact, the rectifier and contact 2*B*. Relay No. 1 closes contacts 1*A* and 1*B*, the latter completing the ignition circuit up to the time-limit ignition switch. Closing this switch at the control station completes the ignition circuit and energizes the pilot gas-valve coil. If everything functions properly, the pilot flame is started and makes contact with the Protectoglow electrode.

Before the pilot flame contacted the Protectoglow electrode, the electron-tube grid and plate had the same potential, therefore current could not flow through No. 2 relay coil. The flame contacting the electrode grounds the grid. Its potential is thus reduced and sufficient current can flow through the tube to close relay No. 2. This relay closes contact 2*C*, opens contact 2*D*, and transfers contacts 2*A* and 2*B*.

Transferring contacts 2*A* and 2*B* shunts out the gas-valve interlock button so that the hand valve can be opened. Relay No. 1 is connected on part voltage to hold it closed. Contact 2*C*, closing completes the motor circuit on electrically operated gas valve and this valve opens.

When the hand-operated gas valve is opened the burner flame is ignited and contacts the Protectoglow electrode to maintain tube-grid ground. Relay No. 2 remains energized. The ignition-switch timer opens automatically three minutes after being closed. Contact 2*D* opening causes pilot-lamps to go dark and shows the burner has gone into operation.

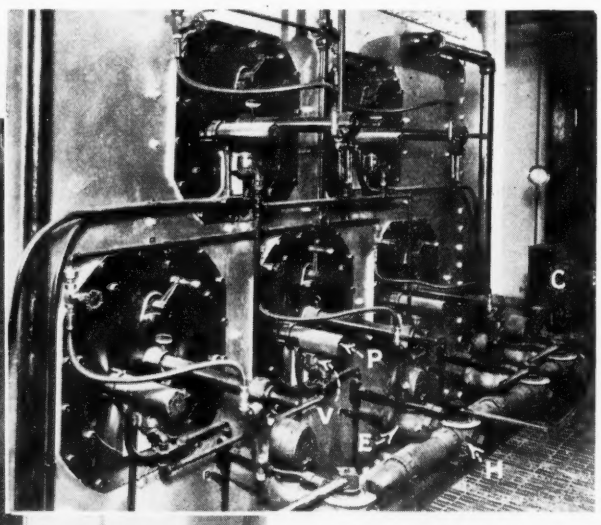


Fig. 2 (Above)—Five gas burners with their protective equipment

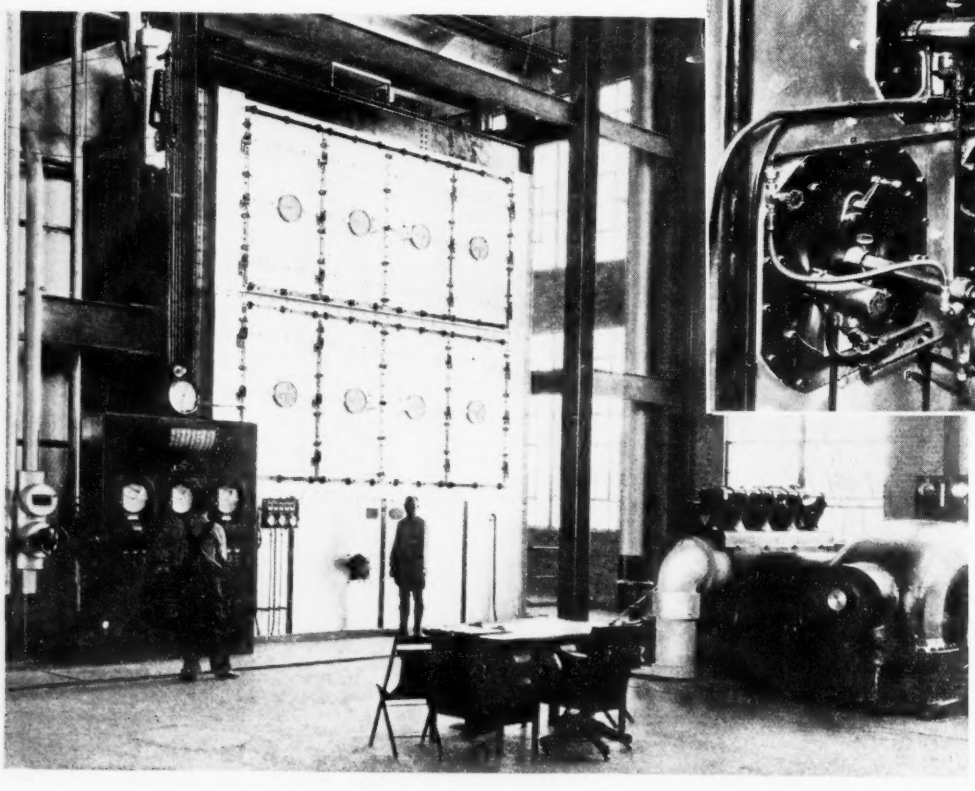


Fig. 1—The 5,000-kw. turbine and 6,110-sq.ft. boiler form a unit; operating steam conditions 400 lb. and 750 deg. F.

If gas fails and the flame is extinguished, the grid-glow tube deenergizes relay No. 2. Contact 2*C* opens and releases the main gas-valve motor, and this valve closes. Contact 2*D* closes and the red pilot lamps light up, showing that the burner is out. Contacts 2*A* and 2*B* are transferred, the former connecting No. 1 relay coil through the gas-valve interlock button (which is open) and No. 1 relay drops out. The pilot flame cannot again be started until the burner hand valve is closed.

As previously mentioned, the main control valve for the five burners is interlocked with the induced-draft fan so that if this fan stops the valve will close automatically and cut gas off from all burners in operation. As soon as the fire is extinguished, the electrically-operated valve on each burner is released, and closes. Consequently, two valves to each burner close to prevent gas leaks into the furnace. Before burners can be started again, the hand-operated valves must be closed.

After the furnace has been put into operation manually, it can be switched to automatic control. On the steam-pressure switch in this system there are two contacts, one for more fuel and air, the other for less. In the fuel and air circuits, an interrupter runs continuously so that when a circuit is closed for a change in fuel and air, the change is made in steps until adjustment meets steam demand. Opening or closing the electrically operated gas valve changes the fuel supply. Regulating amount of fluid in the hydraulic coupling to control induced-draft-fan speed adjusts air supply.

If the original adjustment of fuel and air is not exactly correct, the gas-flow air-flow meter takes control and makes final adjustments by changing induced-draft fan speed. The furnace-pressure control functions to maintain correct furnace pressure by controlling forced-draft-fan speed through its hydraulic coupling.

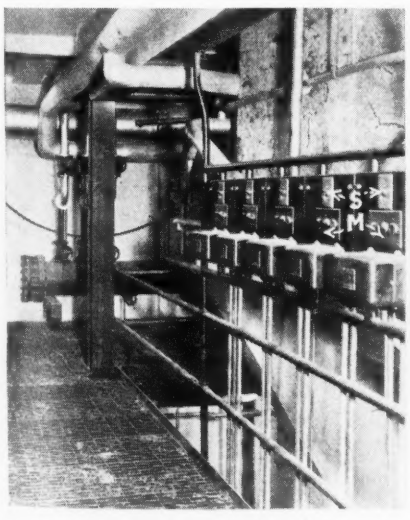
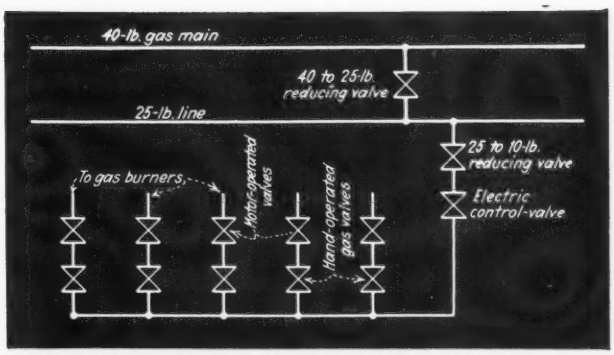


Fig. 3 (Left) —Starting-pushbutton stations for the five gas burners

C, electrically operated, main-control valve in gas line; *H* and *E*, hand-operated and electrically operated valves in series with burner; *P*, Protectoglow prevents dangerous operation of the burners; *V*, electrically operated pilot valve; *M*, pushbutton switches and red pilot lights for burners; *S*, time-limit ignition switches.

On the boiler control board, a six-point switch allows the operator several combustion-control combinations: Full automatic control; automatic control of air and manual control of gas with the air-flow-gas-flow meter functioning to supply the correct amount of air automatically; automatic control of furnace draft and manual control of gas and air; and full manual control. In addition to the pushbutton switches and combustion-control equipment on the control panel, a seven-point gage indicates draft at the induced-draft-fan intake, in the furnace, at the boiler outlet and at the air heater outlet, steam pressure, feedwater pressure and boiler water level. Other meters record combustion-air temperature; steam flow, pressure and temperature and integrate steam flow.



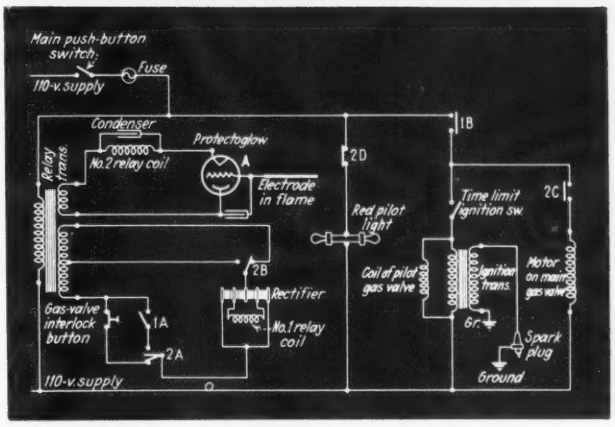
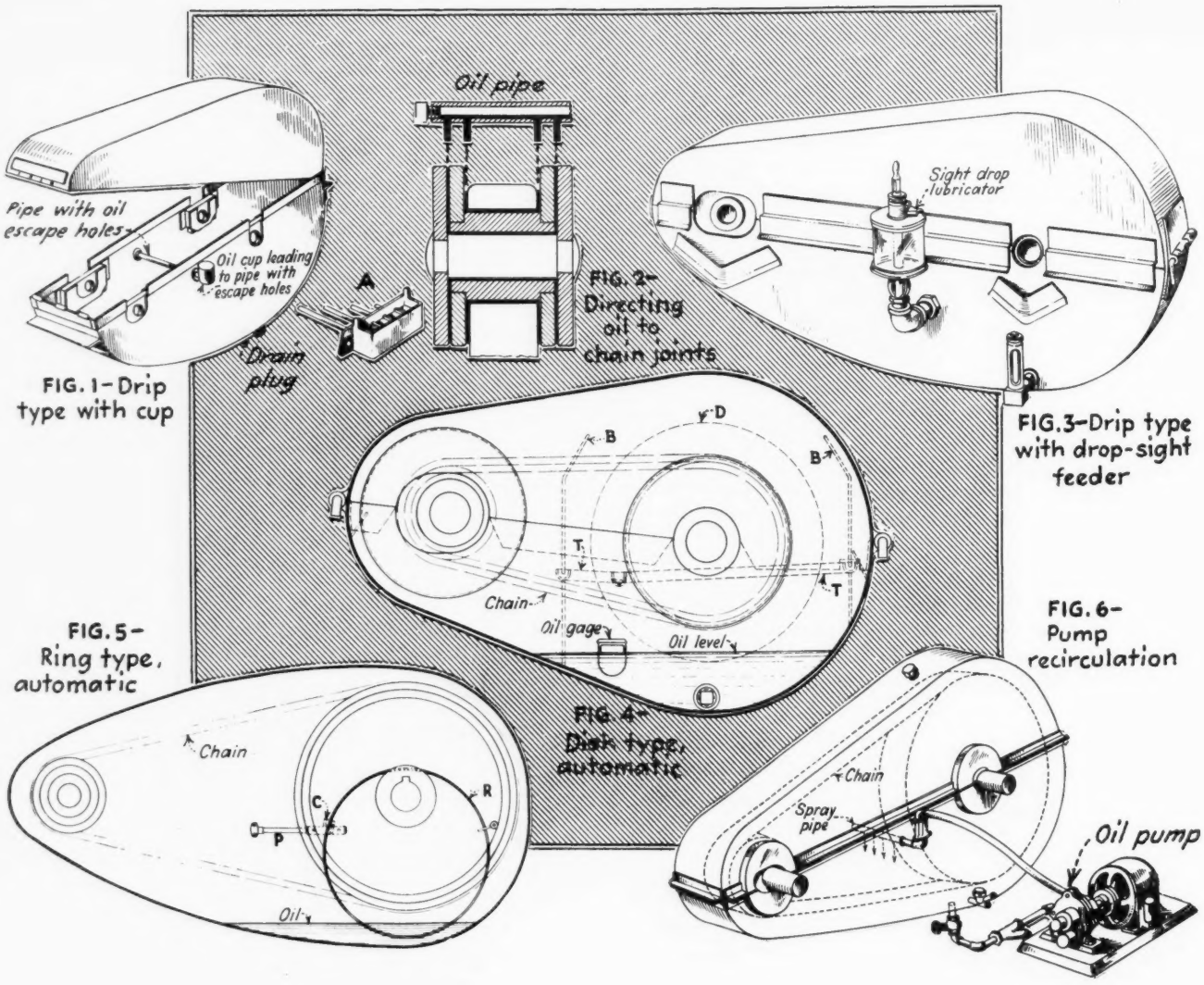


Fig. 4 (Top) — Layout of main piping to gas burners. Fig. 5—Diagram of gas-burner electrical protective equipment

Power is normally generated by this 5,000-kw., 6,900-volt, 60-cycle turbine-generator with direct-connected exciter. The turbine, when operating with steam conditions of 400 lb. gage and 750 deg. F. total temperature, has a full-load water rate of 9.8 lb. per kw.-hr. It exhausts into a deaerating-type condenser and bleeds at two points for feedwater heating. Makeup feedwater is supplied from an evaporator, and feedwater is heated in three closed heaters in series.

A close check is maintained against contamination of the feedwater by condenser leakage. A condensate tester on the switchboard tests condensate once per day, when the load is light. It has been possible to keep the feedwater practically free from impurities. Continuous blowdown is installed on the boiler, but experience has shown that it is not needed, and its use has been discontinued. A very small amount of compound keeps the boiler free of scale, and it is blown down at long intervals only. This operation is performed more to insure that the blowoff valves are in working condition rather than to reduce the concentrates in the boiler. Boiler-feed makeup is very low, being less than one % when the plant is operating on about 28% load factor. *(Continued on page 127)*



PROPER OILING ADDS LIFE

Simple rules for selection, maintenance and lubrication produce long life and high reliability in chain drives

CHAIN drives have many moving parts operating at bearing pressures of 700 to 2,000 lb. per sq.in. If these surfaces are not properly lubricated and protected, rapid wear results.

Long life begins with selection—the unit must have sufficient capacity. Peak loads, if they occur frequently, and not motor horsepower, should determine capacity. Undersize chain causes excessive loading of sprocket teeth at chain joints and makes adequate lubrication and dependable service impossible. Where shock loads are frequent, the drive should be able to take them without undue stress; it is usually not possible to compensate for overloading by using more viscous lubricant. This latter practice may relieve the sprockets, but it also may seriously impair chain lubrication because of reduced penetrating ability of the oil.

When a suitable chain has been selected, it should be installed so that a line passing through the sprocket centers makes at least a 30-deg. angle with the vertical. Chain drives have been operated in almost any position, but they work best with a horizontal drive and the tight strand on top (just the opposite of belt arrangement).

If sprockets and sprocket shafts get out of alignment, the resulting side pull causes unequal distribution of sprocket-tooth and chain-joint loading, making proper lubrication impossible, even with an oil bath.

Chain tension should be adjusted so that it is slightly slack. Too much tension increases wear on bearing surfaces; too little allows the chain to jump the sprockets, ride high on the teeth, or break.

Chain length and speed are important in life and lubrication. Comparatively long, slow-speed chains suffer much less bending than shorter, higher-speed chains, therefore are much easier to lubricate.

Cleanliness is vitally important. Casings or other enclosures are now commonly used for chain drives because they promote cleanliness, aid lubrication and

assure safety. Drives that are not enclosed, however, and simply run in a guard, should be lubricated frequently with a good grade of cylinder oil or light vaseline applied to the inside of the lower strand with a stiff paintbrush. When the chain gets gummy, or about once a year, it should be taken off and washed thoroughly in kerosene or gasoline, dried carefully, and relubricated by dipping in a bath of light oil. Soaking or working in the oil will assist the oil in penetrating all joints.

Medium and High Speeds

Drives running at medium and high speeds should be enclosed and lubricated with light mineral cylinder oil by dipping or by force-feed. If by dip, the casing should be filled with oil until it comes about ½ in. up on the lower sprocket. More oil will act as a brake, reduce mechanical efficiency and heat the oil, while less oil will allow the chain to run dry and fail.

If a drip system is used, the oil should drop on the inside of the chain, thus utilizing centrifugal force to help work the lubricant through. Medium mineral oil should be used, and the amount regulated so that the whole chain is lubricated but no oil is thrown off.

At speeds of 1,500 ft. per min. and above, medium and large-size chains should not be run in oil, for they generate enough heat to boil the oil. On such drives, or where sprockets are too small to allow the chain to run through the oil, an oil-throwing disk or oil-throwing arm may be mounted on the pinion shaft. The small amount of oil so picked up is thrown against a baffle so placed that the oil drips on the chain. Light mineral oil is the preferable lubricant. High-speed chains, particularly when multiple-width drives are used, should be enclosed in a case and oiled by pump,

A sight-drop lubricator mounted outside the case is an alternative, adjusted to deliver a few drops per minute to the chain. An overflow sight gage shows height of waste oil in the case, set so that oil overflows when it rises more than ½ in. above the bottom edge of the sprocket.

Several forms of disk-type lubricators are available. In the unit shown in Fig. 4, oil is picked up by disk *D* and thrown against baffles *B*, then runs down into troughs *T* that deliver it to the chain. On the ring-type lubricator, Fig. 5, a ring dips into the oil in much the same way as in a ring-oiled bearing. Ring *R* delivers oil to cup *C*, from which it is led through pipe *P* to the chain. Motion of the chain splashes the oil sufficiently to lubricate across uniformly.

For large high-speed chains, a pump may be used to recirculate the oil continuously, as in Fig. 6. Here a motor-driven pump is shown, although shaft-driven units are also used.

Corrosion

Some transmission and conveyor chain drives are exposed to corrosive environments to such an extent that oil and grease will not offer sufficient protection to standard steel chain. Use of stainless steel is indicated in these instances. Experience with this class of material is reported very satisfactory. Even though special steels relieve the lubricant from protecting the chain from corrosion, it is still necessary to provide lubrication to obtain maximum dependability and life of chain and sprockets. With any chain, if links begin to crowd together, allowing the pins to project, links should be respread and copiously lubricated.

The following transmission manufacturers have cooperated in preparation of this article: Morse Chain

TO CHAIN DRIVES

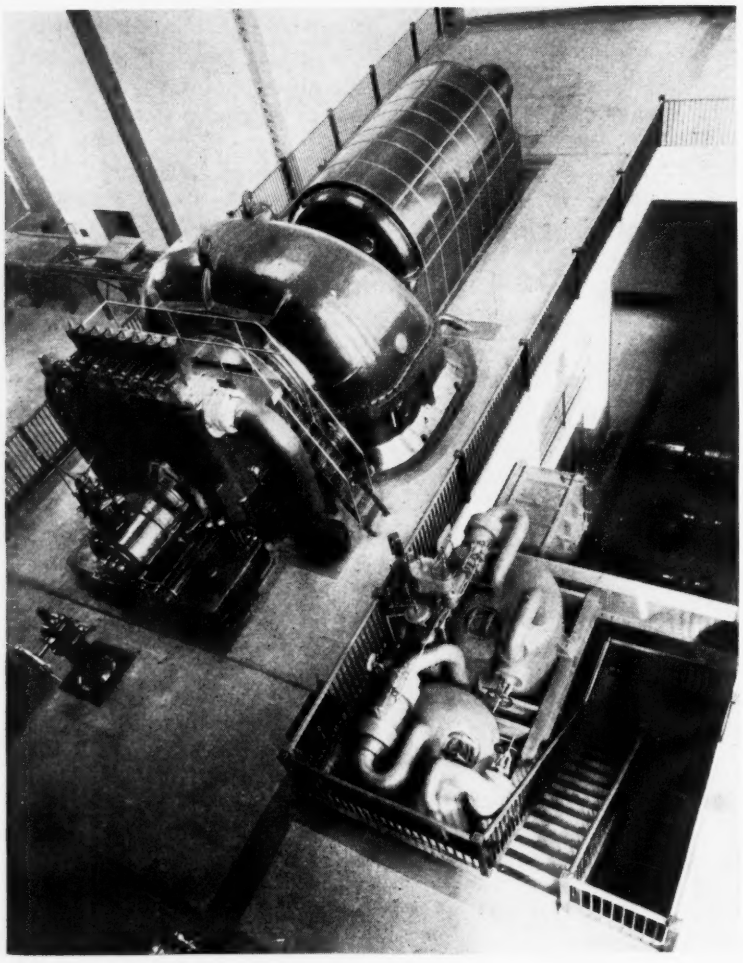
preferably near the sprockets. Light mineral cylinder oil should be used, not heavy oil or grease, because the latter tend to seal clearance spaces instead of penetrating joints.

Where oil is recirculated, as with a pump, it should be replaced after the first three months of use, and at least once a year thereafter if in normal 8-hr. per day service, more frequently if used more intensively.

Oiling devices are legion. Fig. 1 shows one made of a piece of pipe extending across the chain face, with an oil cup outside feeding the pipe. Holes along the pipe allow the oil to drip on the chain. For slow-speed drives, the oil cup may be replaced by a grease fitting and the chain lubricated by grease gun. Fig. 1-A shows a multiple oiler for use with large chains, having pipes of different lengths leading out over the chain from separate oil reservoirs, each pipe having a loose waste wadding at its end to regulate flow. Oil is directed to wearing surfaces of roller chain by the oiler shown in Fig. 2, dropping into joints between side plates and between side plates and sprocket teeth.

Co.; Link-Belt Co.; Diamond Chain & Mfg. Co.; Boston Gear Works, Inc.; Ramsey Chain Co.; The Whitney Mfg. Co.; Baldwin-Duckworth Chain Corp.; Chain Belt Co.; Jeffrey Mfg. Co.; Dodge Mfg. Corp.

SQUISH—This sounds like an absurdity and looks like a misprint, but it is a new technical term, introduced, of all places, before the Institution of Mechanical Engineers in London, England, last Dec. 14. Colloquially used in Europe for some time, it first appeared formally in a paper by J. F. Alcock on "Air Swirl in Diesel Engines" and was recommended in discussion to the notice of the British Standards Institution. What does it mean? It means simply "the radial inwards movement of the air or gases in the cylinder of an internal-combustion engine when the piston approaches the end of its upstroke and air compressed in the diminishing clearance passes toward the combustion space"—or so reports *The Power Engineer*.



Adjacent to the 30,000-kw. turbine are the 14th- and 11th-stage heaters, on which is the condensate valve which controls supply to the 14th-stage heater

Operating CONTACT HEATERS

By C. E. Miller and M. J. Boho

Potomac Electric Power Co

Buzzard Point is one of the few plants that have thus far installed this type of unit. Here are experiences there

MAXIMUM efficiency consistent with simplicity and low cost was the controlling thought behind installation of direct-contact feedwater heaters at Buzzard Point Station of Potomac Electric Power Co. Direct-contact extraction feedwater heaters not only heat feedwater to the full saturation temperature of bled steam, but also extract a greater quantity of steam from the turbine than would be possible with closed heaters, resulting in a lower B.t.u. rate per kw.-hr. Use of contact-type heaters eliminates troublesome drip pumps, degradation of energy resulting from cascading drips and deterioration and maintenance problems present with closed heaters. They, however, have their own operating problems that are not encountered with closed heaters. It is our purpose here to show what these problems are and how they have been handled.

The features of the heat cycle at Buzzard Point have been illustrated in previous numbers of *Power*.[1] Steam is delivered to the throttle valve of the turbine at 675 lb. pressure and 840 deg. It passes, without reheat, through the main turbine to the condenser, with extraction at three points. The hotwell pump delivers water from the condenser to the 14th-stage heater. An air-operated regulating valve controls admission of water to this heater and is positioned from hot surge-tank level and feedwater flow. The condensate booster pump, which consists essentially of two pumps on a single shaft, direct-connected to a constant-speed motor, transfers condensate from the 14th-stage to the 11th-stage heater and from the latter to the 7th-stage heater. A hot surge tank is directly below the 7th-stage heater and forms a reservoir to supply the boiler-feed pumps.

All heaters are of the open-tray type. Condensate enters at the top and falls over a notched circular weir and through a series of trays in the form of rain. Extraction steam enters at the bottom through an inlet in the side of the heater and mixes with the falling water. The condensate outlet is at the bottom. Each heater is equipped with an adequate vent and vent condenser, making it a complete deaerator.

The 14th- and 11th-stage heaters are near the main unit and below the turbine casing so that condensate from the turbine shell drains to the heaters. 7th-stage extraction steam is delivered first to a desuperheating heater, the steam inlet of which is also below the tur-

[1] *Power*, October, 1933, June 1934.

bine casing. Desuperheated steam is thus delivered to the 7th-stage heater, which is placed high enough to insure positive delivery of water to the boiler-feed pumps at all temperatures.

With contact-type heaters, the turbine rotor is open to the interior of the heater. Under normal operating conditions, a considerable body of water is passing through the heaters, a portion of which might vaporize if the turbine throttle were tripped with a high vacuum in the condenser. This steam, not under governor control, may enter the turbine and cause overspeeding of the unit. There is also the danger of failure of the condensate booster pumps, which might back water up into the turbine blading. To protect against such occurrences an oil operated non-return valve is placed in each of the extraction connections to the main turbine. These valves operate as ordinary checks and will close at any backflow, either of steam or water. In addition, each valve is equipped with a piston held up by oil pressure from the turbine lubricating system. Operation of either the turbine overspeed or hand trip releases oil pressure and allows the piston to fall and close the valve.

Float Controls

To prevent water in the heater backing up into the unit, the system of float-operated switches, illustrated, actuates solenoid-operated valves in the oil pressure lines to the non-return valves. Water rising in a heater operates the float switch, causing the solenoid-operated valve to close the piston to the main oil supply of the turbine and open it to the oil storage tank, thereby releasing oil pressure and closing the corresponding non-return valve. Should water continue to rise in any one of the heaters, a second float at a somewhat higher elevation than the first actuates a motor-operated gate valve in the condensate line to the 14th-stage heater, thereby directing condensate to the cold surge tank, which on occasion overflows to the distilled water tank in the basement. Boiler feeding is not interrupted, however, as a separate distilled-water pump automatically keeps water in the hot surge tank at a safe level.

Normally the amount of steam bled from the turbine depends on the amount condensed in the heaters, which in turn depends on the temperature and rate of condensate flow through the heater. Herein arises probably the most important problem in operation. When the heaters are supplied with too much water, it apparently pours over the entire circumference of the trays in the form of an umbrella instead of falling as rain. Steam entering from the turbine tends alternately to support and collapse the umbrella with a resulting pounding in the heater. In addition, the umbrella stops circulation of any gases to the upper part of the heater and through the vent, which is another contributing factor to heater disturbance.

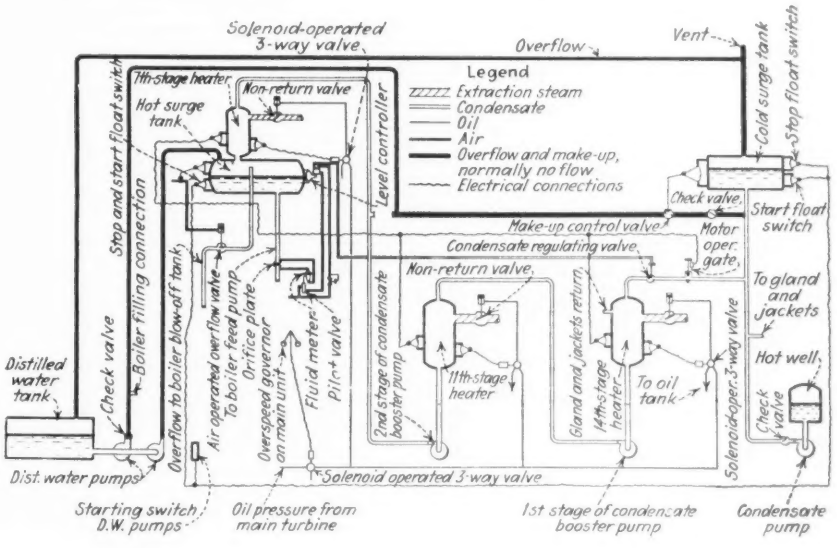
To get satisfactory operation, it is necessary that changes in rate of condensate flow be made slowly and accurately—slowly to keep the heater from pounding, accurately to insure sufficient water in the hot surge tank for boiler feeding at all times. The supply of condensate to the 14th-stage heater is regulated by an automatic level control which takes its impulse equally from the level in the hot surge tank and from the flow of water in the boiler-feed pump suction line. This device tends to anticipate changes in level in the hot surge tank and compensates for the lag of about 3 min. between the time flow changes at the 14th-stage heater and the time it is evident at the hot surge tank.

Operation Simple

Operation of the heaters is simple. The system of floats previously described, together with the air-operated overflow valve at the hot surge tank, makes it possible to start the pumps in any sequence desired. The regulating valve at the entrance to the 14th stage is not tight seating and sufficient water flows through the heaters to keep the pump parts cool in case the booster pump is started before the hotwell pump. Normally all the pumps are in operation before the operator opens, by pushbutton, the extraction valves admitting steam to the several heaters. By manual control, the non-return valves can be left in the "open" position, and the valves will then open under the pressure of steam whenever the main unit is started.

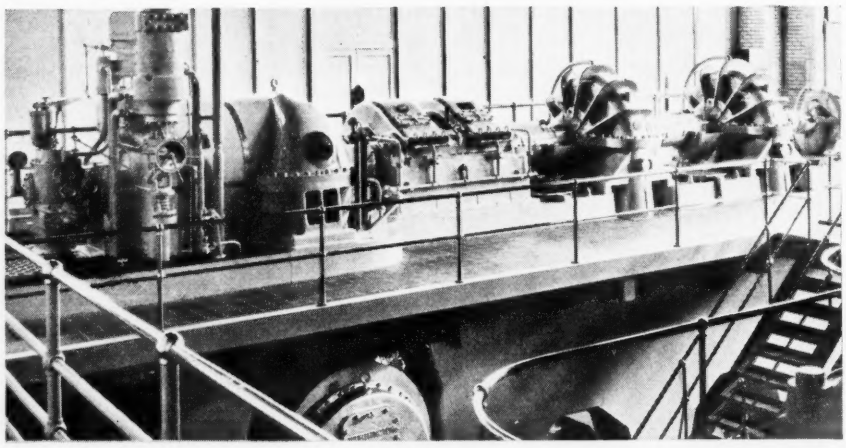
Direct-contact type feedwater heaters have much in their favor; troublesome apparatus is eliminated, heater efficiency is raised to its maximum, operation is simplified and maintenance should be reasonably low. The condensate booster pumps are, however, working under severe conditions for a centrifugal pump. Cavitation of impellers and noise are the principal objections. The only sensitive control in the cycle is that regulating condensate flow to the 14th-stage heater. The combination of 50% control from boiler feed flow to compensate for lag and the other 50% from hot surge level to keep condensate flow from swinging excessively with small fluctuations in the rate of boiler feeding has worked out satisfactorily. Cascading vents has resulted in complete removal of oxygen. Deaeration of the condensate has been complete after the 14th stage even with 1 c.c. per liter of oxygen being admitted to the condensate.

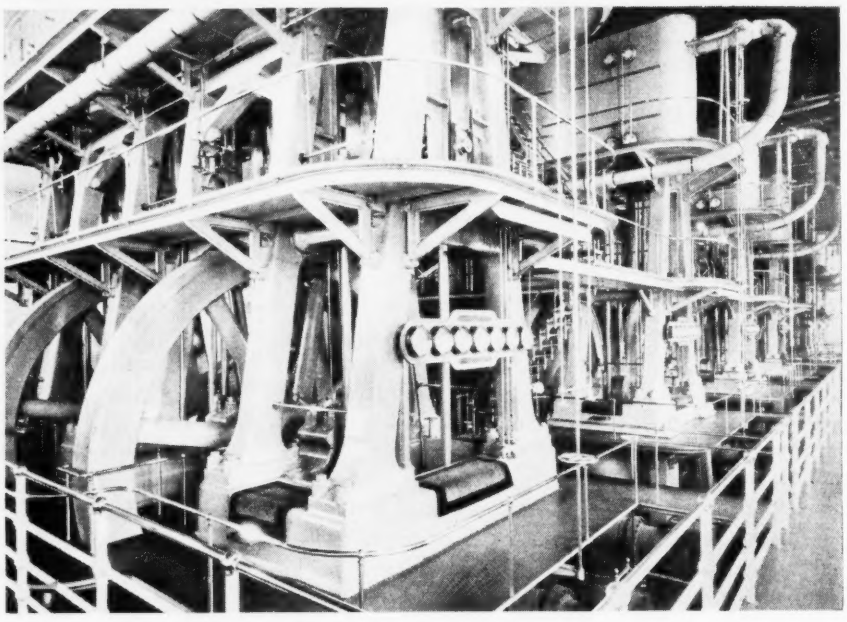
Float and level controls for Buzzard Point condensate system



CINCINNATI WATERWORKS

WENT to THIS . . . from THAT . . .





By R. H. Rogers
Industrial Engrg. Dept.
General Electric Co.

Turbine-driven pump above weighs one-sixth as much, cost one-quarter as much, develops 2.7 times the water horsepower of its engine-driven predecessors below

A STRIKING example of revolutionary changes in waterworks pumping practice is found in the main pumping station at Cincinnati, Ohio. There are few places where units for similar duty are contrasted so sharply. Here, beside a row of seven vertical triple-expansion reciprocating steam pumping engines, a recently installed horizontal turbine-driven centrifugal pump operates under similar steam conditions.

These triple-expansion pumping engines represented the highest development in that class of steam engineering when they were installed in 1907 and 1914 and for many years thereafter. Standing approximately 48 ft. high, each with two 22-ft. flywheels, they run 20 r.p.m. By contrast, the main elements of the new turbine-driven pump, though nearly three times as powerful as one of the old units, could pass through a 12-ft. pipe. This unit, complete with auxiliaries and interconnecting piping, weighs only 125 tons and looks as if it might be an important station auxiliary, instead of a major base-load pumping unit. However, the 25,000,000-gal., 470-ft. head, centrifugal unit develops 2.7 times greater water horsepower, cost only one-quarter as much and weighs one-sixth as much as one of the 25,000,000-gal., 175-ft. head, reciprocating pumps. The steam-turbine-driven centrifugal pumping unit not only fits steam and water conditions of this long-established station but also is readily adaptable to far greater water-horsepower outputs and corresponding pump capacities, as well as higher steam pressures and temperatures.

The main pumping station receives water through a 7-ft. tunnel, 150 ft. underground and over four miles

long, by gravity feed from the clear-water basin of the filtration system. Three of the reciprocating pumping engines are rated 12,000,000 gal. per day against 470-ft. head; one 17,000,000 gal., 470-ft. head; and three 25,000,000 gal., 175-ft. head. The new centrifugal unit carried a guarantee of 188,000,000 ft.-lb. per 1,000 lb. of steam at 160 lb. gage, 100 deg. F. superheat. It actually developed 192,810,000 ft.-lb. at rated capacity and head, on the official trial, exceeding the guarantee by 2%.

The turbine-driven centrifugal pump was purchased from, and installed by, Worthington Pump & Machinery Corp., the 2,500-hp. turbine and speed-reducing gear being built by General Electric Co. The main pump consists of two 20-in. double-suction, horizontal, volute, centrifugal stages interconnected through underneath series piping and operated at 740 r.p.m. for its rated capacity of 25,000,000 gal. in 24 hr. For 75% capacity, its speed is 701 r.p.m., and for 50% capacity, 682 r.p.m. Both stages are provided with bottom-suction and bottom-discharge nozzles. Water flows to them under a positive head of approximately 15 ft. A 16-in., single-stage, double-suction, centrifugal circulating pump direct-connected to the unit supplies turbine-condenser cooling water.

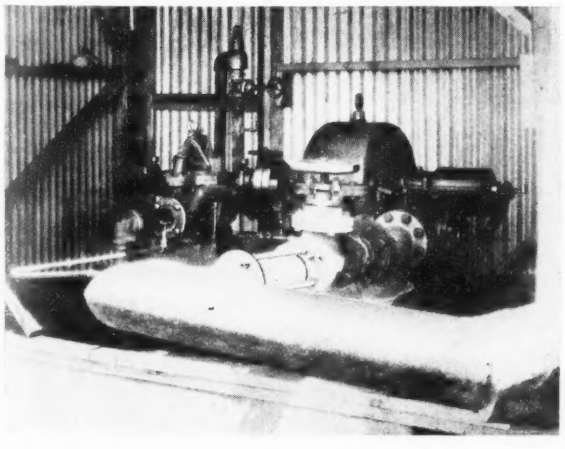
Turbine Rating

Based on steam conditions of 160 lb. gage pressure, 470 deg. total temperature, 1.25-in. absolute back pressure with 70-deg. circulating water, the turbine rating is 2,500 hp. at 3,960 r.p.m. It is of the impulse type with 13 stages. An oil-operated governor has control from half to full capacity of the pump, that is from 3,600 to 3,960 r.p.m. An emergency governor operates to release a self-closing throttle in the event of overspeed. Gear-driven from the turbine shaft, an oil pump supplies lubricating oil under pressure to turbine and reduction gear bearings and to the gear-and-pinion contact lines. A steam-driven oil pump is used during starting and stopping operations.

In addition to the circulating pump there are two condensate pumps each of 70-g.p.m. capacity, operated by water turbines at 2,000 r.p.m. Air-removal is by twin, 2-stage, steam-jet type pumps.

GAS, BUT NO FIRE

Operating on natural gas and driving a centrifugal pump, this Elliott turbine installation, for Athletic Mining & Smelting Co., Fort Smith, Ark., will pay for itself in 6 months. Gas pressure entering the turbine is 45-50 lb. per sq.in., exhaust is into mains at 8 lb. It runs 24 hr. per day, supplying water for a slab zinc plant



Precipitator vs. Cyclone

*By Henry Kreisinger**

TWO methods that have met with good success in catching solids carried by stack gases are the electrical precipitator and the cyclone dust collector. The electrical precipitator gives the dust particles in the flue gases an electric charge so that they are attracted to a plate having an opposite electric charge. Charging of the dust particles is done by high-voltage d.c. ranging between 15,000 and 50,000 volts.

After dust is collected on the plates, it has to be knocked or raked off. During the process of raking this dust off the electrodes, the part of the electrical precipitator which undergoes dedusting is shut off from the flow of the gas. Usually, each unit is provided with three chambers; two may be catching dust while one is being dedusted. The reason for shutting off the section which is being dedusted is to prevent the dust from being carried away by the gases. A station producing 100,000 kw. uses approximately 50 kw. for generating the high-voltage d.c. required to operate the electric precipitator.

The cyclone collector separates the dust by centrifugal force, therefore, it requires more draft than an electric precipitator. The cyclone requires 2 to 3 in. of draft to separate the dust from the gas. A power plant producing 100,000 lb. of steam requires approximately 10 kw. of additional power on the induced-draft fan to supply the draft for the collector.

Electrical precipitators are used almost entirely with pulverized fuel. Cyclones are used both for cinders from stoker-fired plants and fly-ash from powdered coal plants. Cyclones can be counted on to remove from the stack of pulverized-coal-fired furnaces 75 to 85% of the fly-ash in the gas, depending upon how much power is available to do the separation. The electrical precipitator will remove 85 to 90%, or better, depending on how much the apparatus is forced.

Cyclones With Stokers

If cyclones are used with stoker-fired furnaces, the efficiency of separation is higher because the cinders are much larger in size than ash from pulverized-coal furnaces.

The electrical precipitator costs more, but does not take as much power as the cyclone dust collector. The cost of an electrical precipitator has been estimated to be about $2 per kilowatt of capacity of a station. Recently this cost may have been brought down and, of course, depends on the size of the plant. The cost of the cyclone dust collector is about 50 to 60% of the cost of the electrical precipitator. Again, that depends on the size of the station and how much extra duct work must be put in. Usually, duct work is a large part of the cost of the installation.

*An abstract of Mr. Kreisinger's discussion of papers at the 28th annual convention, Smoke Prevention Assn., at Buffalo, N. Y.

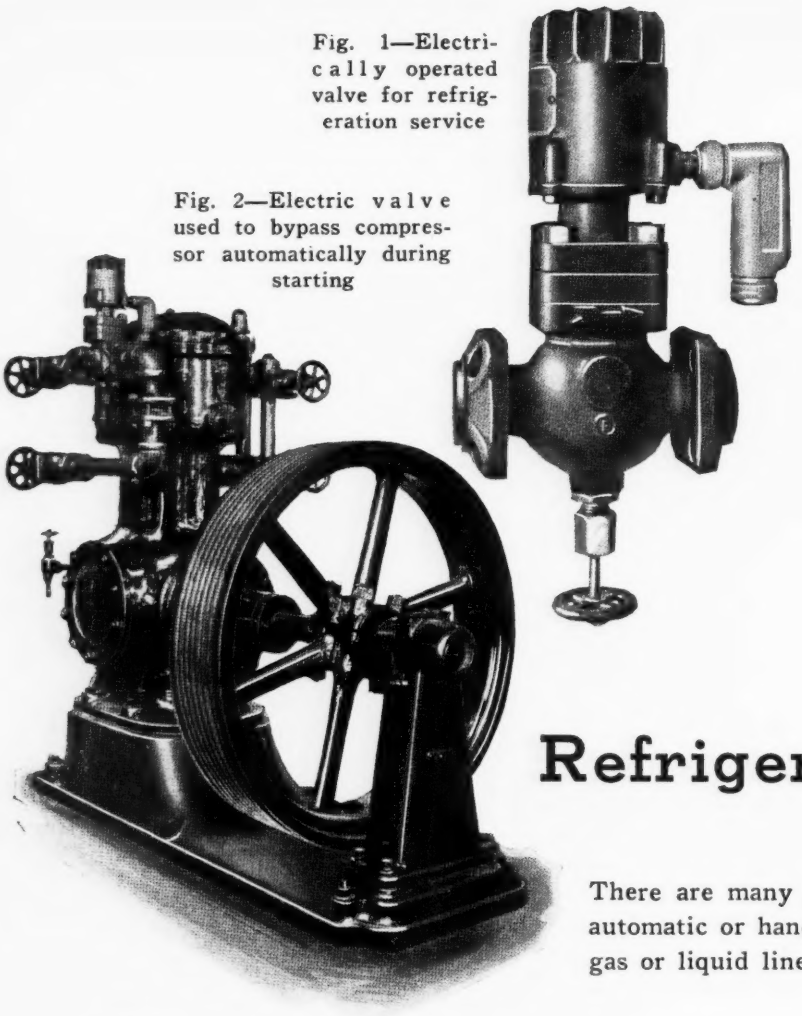


Fig. 1—Electrically operated valve for refrigeration service

Fig. 2—Electric valve used to bypass compressor automatically during starting

By W. R. Kitzmiller

ELECTRIC CONTROL VALVES *for* Refrigerating Systems

There are many possible uses, with real savings, for automatic or hand-operated electric control valves for gas or liquid lines, even as unloaders for compressors

FOR many years, electric control valves have been employed for various classes of service. The first valves had stuffing boxes, which often caused trouble. Some of these troubles were overcome, but the packless valve is now definitely established.

In its development, especially for ammonia, many factors uncommon to other services had to be considered. Of primary importance was a perfect gas seal between the valve body and copper magnet coil. Since steel, iron or aluminum are the only base metals commonly used with ammonia, the rest of the valve had to be designed accordingly.

Fig. 1 shows a 2½-in. packless electric control valve suitable for operation in either liquid or suction lines. It has a full-size pipeline opening and can be used on pressure differentials of more than 200 lb. The handwheel beneath the valve body will raise the valve disk when the magnet is out of service, or control "cut-off."

These valves can be used inside or outside storage rooms. When used inside, the outlet box should always be turned down unless the conduit line is filled with insulating compound. This prevents condensation of moisture which would otherwise finally ground the wiring.

In the wide-open position, the valve requires less than 80 watts. The inrush for a fraction of a second runs to approximately 150 watts, which permits use of practically any standard control device of low current rating.

The first application of electric control valves was for room temperature control. While this continues to be the greatest field, still there are other important applications overlooked in the average plant where time and power savings could be made, for example the compressor unloader. This arrangement corresponds to an automatic by-pass whereby the suction and discharge of the compressor are equalized, as illustrated in Fig. 2. When employing the unloader, several things are accomplished:

First, starting torque is reduced, permitting automatic starting of compressors by low-torque motors.

Second, the compressor shaft is kept turning through dips in voltage, momentary current interruption, and other power irregularities, since unloader comes into action, reduces load and permits motor and machine to carry on. This is especially true of engine-type synchronous motors which normally shut down during severe electric transmission disturbances.

Third, the operator can start the machines from pushbuttons without having to operate valves by hand, thereby allowing more time for other plant duties.

There are other advantages, but one of the most important is saving in demand charges for power. Fig. 3 shows several motors starting with across-the-line

starters and reduced voltage starters. Note at the left, compressor No. 1 starting up unloaded. After running loaded a short time it is unloaded again to start compressor No. 2. After compressor No. 2 is started, the unloader on No. 1 is closed. In this manner, combined power for all three motors is practically the same as the maximum inrush, even with across-the-line starting. The right-hand illustration shows the same type of starting where reduced-voltage starters are used. Actually, the full-plant load is more than the current inrush to the motors. If starting-current values were added to the full-load motor load on the line, the inrush value would be considerably higher.

These curves do not attempt to tell the entire story in starting compressors, since it is evident that if characteristics of certain motors, especially synchronous, are taken into account these curves would actually be lower. When adding the current vectorially at various power factors, different peaks would be obtained. The leading power factor of an unloaded unity power factor motor tends to correct the lagging factor of the starting motor, with a resultant saving of approximately 50% in the total inrush, as shown for across-the-line starting. For 80% p.f. motors, this saving would be still greater.

The fact that starting current for unloaded compressors is only momentary does not limit the value of the unloader. In addition to the features mentioned limited inrush reduces voltage drops.

In many hand-operated plants, the problem of slop-over ammonia often becomes important. In many instances, a change in evaporator design or connections would solve the trouble, but often there are 8, 10, or 15 expansions in one plant, which would involve considerable expense. Electric control valves can help solve this problem effectively. A large accumulator can be installed ahead of the compressors in the main suction line. On the accumulator a float switch (starting a liquid ammonia pump on high level and stopping on low level) will pump back into the main liquid line so that the present hookup of expansion valves need not be disturbed.

Instead of pumping the liquid back into the liquid line under condensing pressure, an electric control valve ahead of this connection closes, permitting the pressure to drop and requiring quite a bit less power to return the liquid. This liquid is then returned to the expansion valves and will be under condensing pressure the instant the pump stops. With this arrangement, expansion valves need not be adjusted quite as "fine" and very little power is used to return the liquid. Furthermore, the short time interval when the main liquid line is closed helps to adjust the excessive flow of liquid which filled the accumulator, and no doubt decreases the tendency for liquid to return.

There are two electric circuits in this automatic liquid return system; one from float switch to electric valve in the main liquid line, the other to the automatic starting switch on the liquid pump. When the liquid reaches the high level the valve circuit is broken, closing the valve and energizing the pump starter circuit. In the starter circuit is wired a pressure switch which prevents the starter from closing until pressure has dropped to the proper value. As soon as the liquid falls to the low level the pump is stopped and the valve circuit energized. The time required to complete this cycle depends entirely on the capacity of the pump selected. One plant reports excellent results with an 8-min. period.

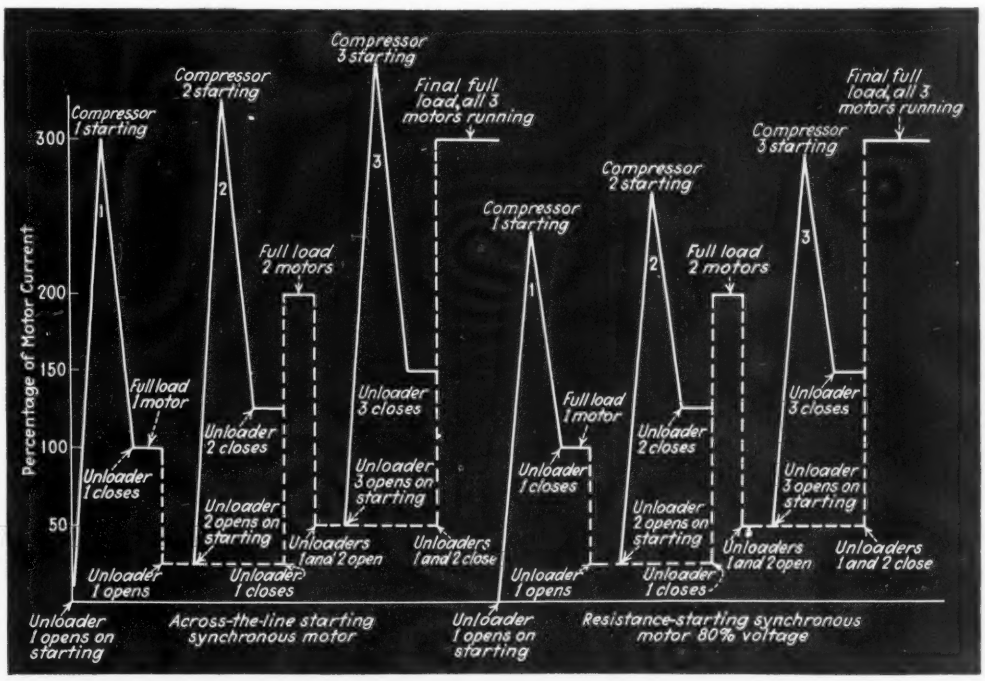


Fig. 3—Current curve when starting an ammonia compressor with automatic unloader

WHAT'S YOURS?

MANY readers of *Power* are power engineers in plants devoted mainly to the manufacture of a single product —newsprint, rubber tires, canned tomatoes, etc. How much steam or coal does it take to produce a pound of newsprint, tomatoes or auto tires? Many engineers would like to know, for these and other products.

Power will be glad to publish such information, either with or without the name of the plant involved. Will you send in the figures for your plant? State what the product is, the pounds of coal (for all purposes) per pound (or other unit) of product, the kind and heat value of the fuel and, if possible, the process steam required per pound of product. If convenient, give also the kilowatt-hours produced per pound of product and state whether power is generated or purchased. The coal figures should include coal for *all* purposes. Please state also whether the name of your company may be used.

Shrewd Diesel Plant Design MEANS CHEAPER POWER

By Paul M. Thayer

Don't just buy a "diesel plant like So-and-So's." Instead, evaluate load characteristics, peaks, duration, fuel oil available, cooling water, lubricating oil purification, auxiliaries, spare parts—for YOUR PARTICULAR CASE

DEPENDABLE power at lowest possible production cost is the primary consideration back of any diesel power project. Proper analysis of the job and fitting the plant to that job are the most important things in working out the design.

Power production cost can be divided, roughly, into two classifications, fixed charges and operating costs. Usually fixed charges are higher than operating costs, and it is of greatest importance to keep them as low as possible consistent with constant and dependable power service. This can only be done when the characteristics and load on the proposed plant are accurately known.

It probably seems absurd to stress this point, but these data are usually more difficult to get than anything else. A case in point is a central generating plant proposed for a group of small mining properties. The only data available were sizes of the many motors and the total energy used per year; nothing was known of peak load. Two diesel builders, when confronted with this information for analysis and recommendation, recommended plants of 17,000 kw., and 4,800 kw., respectively. The small plant was built and proved ample to carry the load. Fixed charges on the larger one would have been at least three times as great, and would have smothered any possible operating economy.

Engineers often think that any plant should have enough capacity to carry its maximum peak load with its largest unit out of service. This is true in some types of service, but is by no means a rigid rule. Usually a part of the maximum peak load can be thrown off without harmful effects, and in many situations peak load occurs only a few hours a year, at periods easy to anticipate. For example, in a plant serving a small community where the maximum peak occurs for a few hours at Christmas, all equipment may be prepared for operation during that time. Standby capacity in such a plant can be based on normal peak load, so long as total capacity is enough to handle the maximum short-time peak.

One often-neglected consideration is capacity factor or duration of load on a proposed plant. It is the ratio of the amount of power actually produced to the amount that would be produced if the plant were operated at full capacity every hour of the year. Examples of the two extremes are a diesel plant serving as standby to a hydro plant, and which may operate only one or two weeks a year, and a diesel plant serving a plant producing electrolytic copper or zinc, which requires operation all year round at full load on the engines. Naturally, since the products and capacity factors of these two plants are so different, their designs likewise should have little in common. In the standby plant, fuel cost is of secondary importance in the electrolytic plant fuel cost is more important than anything else.

After the nature of the load on a proposed plant is known, other factors influencing design are more or less self-evident. Assume that a plant will operate on a base load with high capacity factor. Fuel cost automatically becomes a major consideration. In some sections of the country there is little difference in the cost of heavy refinery residues and the lighter grades more commonly used in diesels. In other sections this differential is considerable. Obviously, all types of fuels available at a given plant site should be studied, not just those classified as "diesel fuels" by the refiners.

A few years ago I instigated a test to determine whether fuel oil having a viscosity of some 4,000 sec. Saybolt Bé. 5, carbon residue about 15% Conradson, and a very low price, could be burned successfully in an air-injection diesel. The test proved conclusively that if oil were heated to about 180 deg. F. it was satisfactory. Probably fuel consumption per kilowatt-hour and maintenance would be increased slightly, and some means for heating the fuel storage tanks and daily supply tanks would be required, as well as means for heating tanks in order to unload them. But these complicate plant layout and increase first cost; further, the air-injection diesel is more complicated than the solid-injection type. These factors preclude use of this type of fuel, except where capacity factor is high and low-gravity fuel oil is available at a decided saving over fuel suitable for use in solid-injection engines.

Water May Be Too Soft

An adequate supply of satisfactory cooling water is vitally necessary. Cooling water that deposits scale in water jackets plays havoc with any cost sheet. Where relatively soft and scale-free water is available, it may not be necessary to use the closed system, but in many cases the closed system is well worth the added cost.

particularly where raw cooling water is taken from a stream carrying appreciable amounts of suspended matter.

Conversely, it is entirely possible to have water too pure for safety. This may sound like a paradox, but the facts are that water too low in certain soluble matter may attack the jacket. This must be corrected by adding minerals or salts. When a cooling tower or pond is used, some provision must be made to prevent the water from becoming too heavily charged with scale-forming sediments, due to the concentrating action of continual evaporation.

Such troubles can be largely forestalled by investigating beforehand and designing the plant accordingly. Many plants that show unduly high maintenance costs can trace this difficulty directly to the lack of a properly designed cooling-water system. Just because a given system is exactly right for one plant in one location, it is not necessarily suitable for other plants in other locations and operating under altogether different conditions.

Lubricating Oil

Another factor that must be considered in laying out a plant is the question of lubricating oil. Most diesels nowadays have some form of built-in lubricating oil filter and circulating pump. This is all right as far as it goes, but if no other facilities are available to handle and reclaim the oil periodically, lubricating oil cost will be much higher than it need be. Some plant designers favor the unit system of lubricating oil purification, i.e., having each engine equipped with its own centrifuge or other equipment. Other designers lay out a plant so that there is one central lubricating oil purifying unit with all engines piped to a central dirty-oil tank. Thus, any engine can be drained into the dirty-oil tank and can be refilled from a central clean-oil tank, the dirty oil then being purified at the operator's leisure. Usually the latter system is less expensive and results in pure oil because of the increased time available for purification, as well as insuring a supply of clean lubricating oil for use in emergency.

Auxiliaries to Fit Operation

Auxiliary equipment must be laid out in accordance with the type of service. If the plant will always operate as a unit, then auxiliaries should be laid out to have as few elements in operation as possible at one time. Thus, it might be advisable to have two cooling-water pumps, each able to supply enough cooling water for the entire plant, one to operate and the other to act as standby. If on the other hand the plant will usually operate only one or two engines, it is often advisable to design auxiliaries so that each engine has its own set. Each case must be studied individually, considering both initial investment and power requirements.

The question of spare parts is important. Many plant designers pick out engines entirely from the standpoint of lowest possible fuel consumption and try to have a series of engine sizes that correspond to the varying load on the plant. This may result in two or more cylinder sizes, and thus at least two complete sets of spare parts, with consequently greatly increased initial cost. Likewise, any plant that enjoys normal growth may have newer engines of different sizes, even of different makes in the initial installation. Usually such a plant arrangement eventually becomes a reality, but there is no need to handicap a new plant more than necessary by starting out that way.

The advantage of having engines in sizes to fit varying load is more apparent than real. The modern diesel has a very flat fuel consumption curve, and larger engines are enough more efficient than smaller ones practically to wipe out any theoretical saving, whereas the disadvantages of different-sized parts may prove very real. One important factor often forgotten is the earlier obsolescence of the smaller unit, due to increased plant loading.

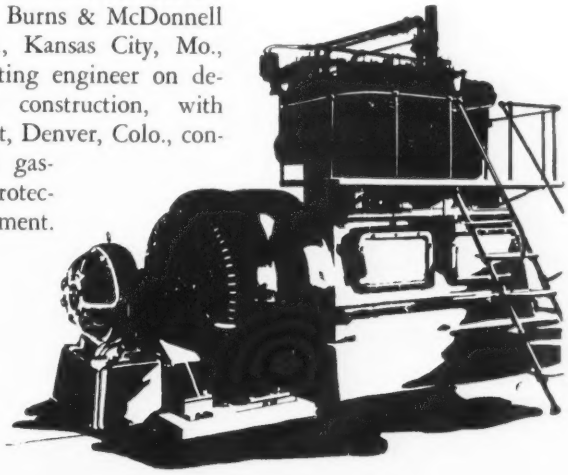
The plant designer has just two major things to consider in laying out his plant: first, what the plant is to do—the load and all its characteristics; second, what the plant is to do it with—the fuel oil and the cooling water. If these things are thoroughly investigated and understood, and the plant laid out accordingly, the results can be accurately predicted, and the plant will live up to all expectations. It is just as important for a diesel plant designer to know what the proposed plant has to do, and what it has to do it with, as it is for a tailor to know the dimensions of his customer and the character of his cloth in order to turn out a satisfactory suit of clothes.

Colorado Springs

(Continued from page 117)

The steam unit supplies that part of the load above that taken by the hydro plants and serves as standby capacity on the system, consequently operates at a low load factor. In spite of these conditions, a fairly high annual operating efficiency is obtained. For the first eleven months of 1934, average boiler and furnace efficiency was 82.0 per cent. In the same period, average B.t.u. required per kw.-hr. were 19,710. In 1932, the last year that the old units operated, the average B.t.u. per kw.-hr. were 27,500. Thus, the new unit shows a saving of about 28 per cent, which indicates the increased efficiency of modern equipment over that of only 10 years ago. With a reasonably good load, the new unit can produce 1 kw.-hr. on 17,000 B.t.u.

L. H. Shute, electrical superintendent, is in charge of power system operation, and the steam plant is in charge of Fred H. Wiley, chief engineer, to both of whom *Power* is indebted for information. Burns & McDonnell Engrg. Co., Kansas City, Mo., was consulting engineer on design and construction, with W. A. Flatt, Denver, Colo., consultant on gas-burner protective equipment.



AUTOMATIC ZONED-AIR CONTROL FOR CONNORS CREEK STOKERS

Continuous smokeless operation at high ratings achieved on large stokers burning up to 75 lb. of coal per hr. per sq.ft. of grate indefinitely

By Thomas Wilson

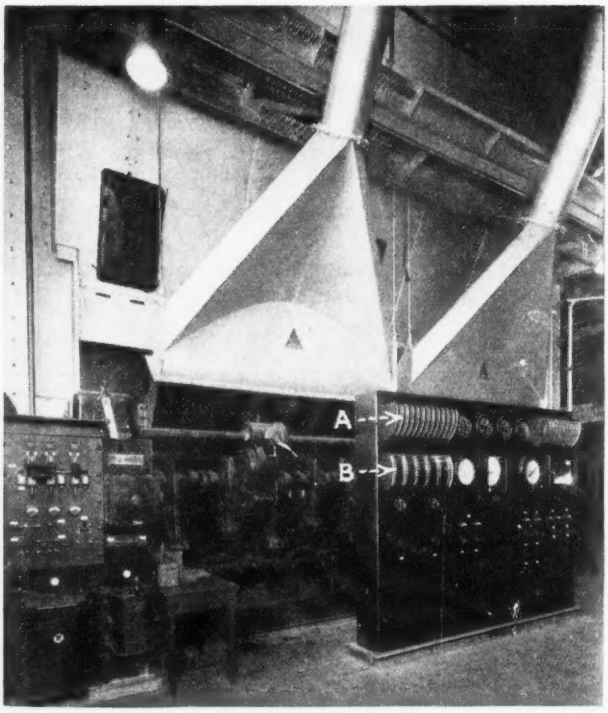


Fig. 1—Control panel on right with six zone meters and the twelve flow meters for the twelve divisions in each zone shown at *B* and *A* respectively.

FOR several years Detroit Edison Company has pioneered in metered control and regulation of underfeed-stoker air supply. Higher continuous rates of combustion, smokeless operation and improved efficiency have been attained.

The basic idea is to sectionalize the stoker grate into small areas. By adjusting air supply to each area, proper flow can be maintained to every part of the stoker regardless of fuel-bed resistance; consequently, each section burns its share of fuel. Results obtained in an initial installation at the Company's Beacon Street heating plant indicate a possible increase in maximum continuous steaming rate of 20 per cent with improvement in efficiency at all loads.

At Beacon Street, air control is manual, but it is semi-automatic for the new boilers and stokers at Connors Creek (POWER, *February*). The first of four boilers is in operation and showing excellent performance. These are double-ended, with 26,764 sq.ft. of steaming surface each, delivering 330,000 lb. per hr. at normal full load, 710 lb. gage, and 850 deg. total temperature. The double-ended underfeed stokers have 12 retorts and nominally are 29 tuyeres deep. A special thin tuyere has been developed, however, so that there are actually 41 tuyeres in each stack.

To provide air control, each stoker is divided into three zones extending across its 12 retorts. As indicated in Fig. 3, the upper zone includes 23 tuyeres, the middle zone 18 tuyeres; the extension grates form the lower zone. Each zone is divided into twelve sections, each including the space from the center of one tuyere to the center of the next. Thus the fuel bed is divided into 72 sections, 36 per stoker. From each of these areas, metal inclosures lead down into the stoker windbox, each enclosure being provided with a control damper and a venturi metering throat.

The forced-draft fan above the boiler delivers combustion air through the preheaters to the windbox under the entire grate surface. From this chamber, air passes through venturi throats, damper boxes and tuyeres into the fuel bed. Hays differential air meters indicate quantity of air flowing to each zone and also passing through each venturi throat, the meters being calibrated to read directly in cubic feet per minute. They are mounted on a single control panel carrying all boiler instruments, Fig. 1. At *B* a 6-unit meter assembly indicates air flow to each of the six zones. A 12-unit meter *A* shows flow to each of the twelve divisions of any one zone. By means of valves the 12-unit meter may be switched from one zone to another to show air flow across the zone.

A Cash diaphragm regulator controls air quantity to each venturi throat. A zone regulator applies a bias to the individual regulators for each stoker zone. Zone regulators are adjusted manually and by air pressure superimposed by a master controller. For a given load on the zone regulator, air flow through the twelve venturi boxes of a zone is automatically regulated. This assures passage of an equal quantity of air through all the boxes, even though fuel-bed thickness,

and consequently resistance, may be different for all sections.

When a large stoker is operated with the usual air control, it is difficult to maintain the fire at high ratings for a considerable time. As the fuel bed is never entirely homogeneous, the upsetting process may start at any point of the grate. The fuel may burn thin, lessening its resistance, so that increased air flow will increase the combustion rate locally. The thin spot soon becomes a hole that will not fill up because of the air blast from the tuyeres. On another part of the stoker, the fuel bed may become thicker, restricting air flow and reducing the combustion rate at that point.

In a large furnace these irregularities result in extreme variations. At high combustion rates the changes are rapid, so that unbalancing is well under way before it can be observed. Eventually the fire becomes unmanageable and has to be remade. The disrupting condition takes some time to complete, varying from a few minutes to perhaps an hour or two. This explains why high combustion rates can be maintained for short periods only.

With zoned air control, local thinning of the fire does not cause an increased flow of air, nor does a thicker fuel bed reduce the air supply. Air flow is controlled so that progressive fuel-bed unbalancing cannot even start. The regulators check local excessive air flow and increase supply to any deficient section. It is thus possible to maintain indefinitely a uniform fuel bed at considerably higher steaming rates than with the older type of control.

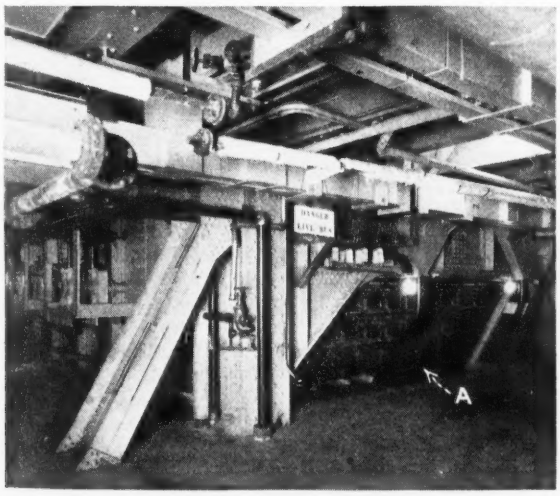


Fig. 2—Air control as now developed involves many units, located above *A*. Their number will be realized by noting their positions in the photograph.

Comparative results have been obtained by operating one boiler with and without the air-flow controls. With the controls in operation, high ratings can be obtained continuously without smoke. With the controls out of service, the valley between stoker ends fills with ash and clinker, smoky operation develops and steaming capacity decreases. With resumption of zone control, operation comes back to normal.

It was thought that less air is needed through the extension grate zone than in the upper and middle zones. The meters disclosed that for best results the reverse is true—at high fuel-burning rates, over half the combustion air is required by the extension-grate zone, in fact it is difficult to force enough air through this part of the fuel bed. From the lower end to the top of the grate, the approximate proportions of air giving best results were found to be 55, 30 and 15%. When air through upper-zone tuyeres is reduced to 15% of the total, a more active fire may be built at the lower end of the middle zone and on the extension grates. By maintaining these proportions, combustion results have been improved.

While semi-automatic control in the present installation relieves the operator from continuous adjustment of dampers, it has not removed the human element entirely. Dependence still must be placed on the operator's judgment. For large changes in load, he sets the zone regulators and checks the automatic control by meter readings.

Although the multiplicity of meter and control equipment and the elements dividing the fuel bed are expensive, the air control system as a whole is considered well worth while. Continuous satisfactory performance at high ratings and 20 per cent increase in capacity not only permit reduction of stoker size, but in a large plant reduce the number of boilers. With the new boiler, combustion rates up to 75 lb. of coal per sq.ft. of grate may be maintained for long periods. It is the conviction of the management that this form of air control will permit large underfeed stokers to compete successfully with other forms of fuel-burning equipment.

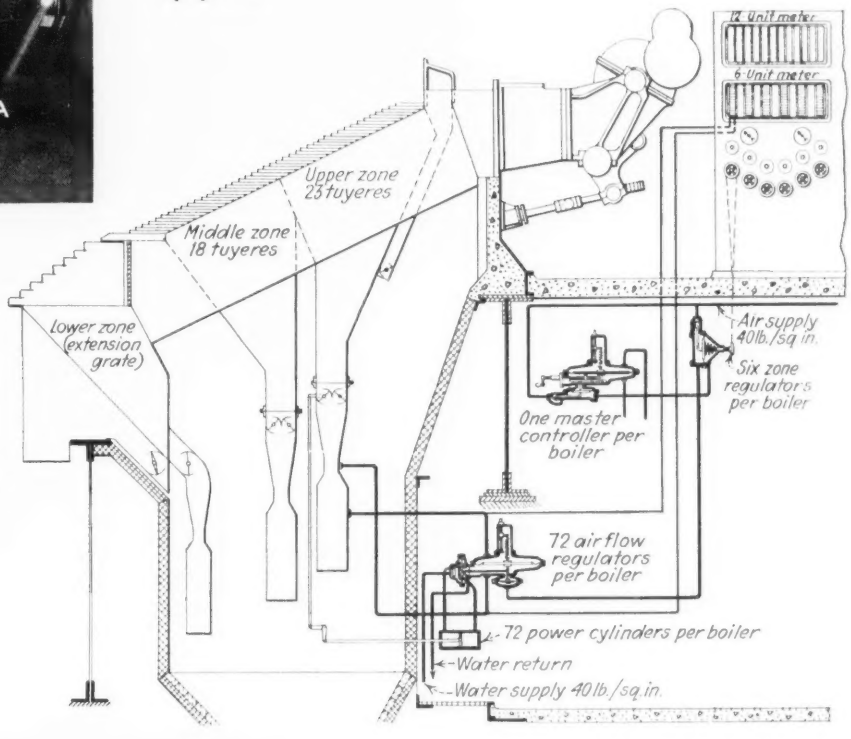
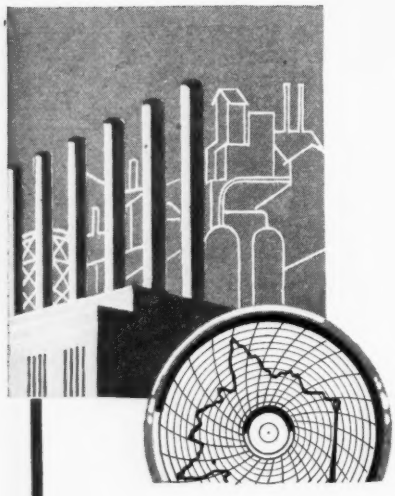


Fig. 3 (Right)—Air-flow control system including the air meters on the boiler control panel.



SOFT SPOTS
IN STEAM GENERATION

By Charles W. McBreen
Chief Engineer, Rockland State Hospital

SO MUCH has been written about correcting boiler room faults to improve economy that it is hard for an engineer to keep in mind all the factors that make the difference between economical and wasteful operation. For that reason, I believe the following outline of faults and remedies may help many engineers who are trying to bring their plants up to a high level of performance. For the sake of simplicity, coal is the only fuel considered, but many of the faults and remedies listed will apply to plants burning other fuels. Space limitations do not permit dealing with unusual cases.

First Consider Boilers

Scale and other faults resulting from bad feedwater reduce heat absorption, cause priming, corrosion, etc. Clean water side of heating surfaces down to bare metal where possible. Stop or check scale formation and corrosion by better feedwater treatment, preferably outside the boiler, and by filtration.

Carbon deposits on fire side of heating surfaces block heat flow. Scrape or brush down surfaces to clean metal. Reduce amount of soot deposit by better or more frequent blowing with steam or air. Mechanical soot blowers usually pay out in a short time.

Improper or leaky baffling sidetracks good heating surface and reduces heat absorption by the boiler. Repair baffle leak with tile and plastic fire cement. If baffllles are badly placed, change baffling so that all parts of the heating surface are swept by gases if available stack-draft is sufficient.

All three of these faults—scale, carbon deposits, faulty baffling—can be detected either by inspecting the cold boilers or by measuring the temperature of escaping gases in the last pass or uptake of the boiler. Look out for errors in measuring temperature. The pyrometer or thermometer must be accurate, must be directly in the path of escaping gases and must be far enough away from water-cooled surfaces so it is not affected by them. Boiler settings and breechings must be free from serious air leaks.

In many plants much steam is frequently wasted through blow-off valves and other boiler connections. Watch for visible signs of such leakage. See whether the blow-off lines remain hot between blow-down periods. Repair or replace leaking valves. Set up a system of periodic inspection to forestall similar losses in the future.

Inefficient Furnaces and Coal-Burning

Coal not suited to the equipment causes waste and trouble. Coal choice is usually determined by the type of equipment installed, rather than by the personal preferences of the engineer. Furnaces, grates and stokers designed for small-size anthracite are, in general, entirely unsuited for operation with eastern bituminous coal, and vice versa.

If the kind of coal is already fixed by existing plant conditions, the most economical coal for the plant can usually be chosen on the basis of B.t.u. obtainable for one dollar, but the peculiar characteristics of each grade of coal must be considered as far as they affect boiler capacity, economy and maintenance cost with the type of fuel-burning equipment installed.

If bituminous coal is required, you must consider the percentage of volatile matter and the fusion point of the ash as well as coal heat value. Beware of high-volatile coal where furnace volume is small and smoke laws are strict. Look out for trouble with low-fusing-temperature ash if mechanical stokers are installed where high boiler ratings must be obtained.

If several available coals give about the same B.t.u. per dollar, it is wise to test each in actual plant operation over a period of several days or even weeks. Operation gives the final answer. Time and again, plants fired with underfeed or overfeed stokers have given excellent economy and high ratings with high-fusion coal and fallen below par in both respects when operation was shifted to coal of equally good heat value and proximate analysis but of much lower ash-fusing temperature. Fusing point of ash is less important with hand-fired furnaces, but volatile content is likely to be more so. It is almost impossible to hand-fire high-volatile coal without smoke, even at moderately high capacities.

Improperly designed furnace or grates require pampering. Where radical changes of furnace design are not possible in an existing plant improved results can usually be obtained by changing the fuel or adjusting rate of combustion. Combustion rate can be increased or decreased by changing the number of boiler units in operation to suit load conditions. Where such flexibility in operation is not possible, the ratio of grate to heating surface can be changed by blocking off or extending hand-fired grates, or, with certain stokers, by limiting the active grate surface as far as possible.

Most old boilers have too little furnace volume. This fault is hard to cure, but in some cases the floor can be lowered or the boilers raised. Except as an aid to the smokeless operation, arches and special furnace or combustion chamber brick construction changes are of doubtful value and may increase cost of maintenance and operating trouble.

Inefficient boiler settings waste steam dollars. The majority of old plants have this fault. Inspect brick boiler settings frequently for cracks or other air leaks (include all observation doors and other openings and all joints in the uptakes and flues). Air leaks in uptakes and flues do not, of course, directly affect furnace efficiency, but they may indirectly by reducing stack draft. They also give misleading stack temperature and CO_2 readings. The candle is the best test for leaks.

Best remedy for setting leaks is covering the outside walls with an improved plastic air-tight compound. Next best is caulking cracks and plastering leaks with a mixture of asbestos and fire clay. Plug leaks at setting openings by refitting or replacing covers and (temporarily) with the fire-clay-asbestos mixture, which can also be used for tightening joints in uptake and flue.

Uneconomical rates of combustion, improper firing and control of air supply waste large sums. Every type of stoker or grate has its own most efficient combustion rate; a rate much higher or much lower is wasteful of fuel. The loss, of course, may be balanced by gains in over-all boiler unit efficiency or general plant efficiency from better use of auxiliary equipment, but the general run of boiler plants give best results at the normal combustion rate. Designers of furnace and grate equipment should be able to say what that most economical rate is. In general, a rate slightly above normal is better than one slightly below, where load conditions permit. This is especially true of hand-fired or underfeed-stoker fired boilers.

Banked Boilers

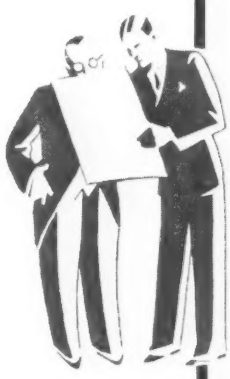
Banked boilers are wasteful and should be avoided in a plant continuously operated, except when absolutely necessary to insure safe operation over peak-load periods. Peak loads can usually be carried with the boilers in regular operation if load conditions are studied.

Banked boilers are unavoidable in part-time operation, but it will usually be more economical to reduce the number of units in service and operate them at somewhat higher combustion rates.

Proper regulation of air supply to suit the fuel-bed condition and rate of combustion is probably the most important single factor in obtaining high furnace efficiency and fuel economy. This control is best obtained with the aid of CO_2 recorders or of instruments showing the relation between draft loss through the fire and that through the boiler, or the relation of steam output to draft loss through the boiler. All of these instruments should be calibrated regularly by CO_2 Orsat analyses.

In general, CO_2 should be kept as high as possible without appreciable amounts of CO, up to the point where the loss due to unburned carbon in the ash balances the gain. Sometimes the CO_2 reading is carried to a point where carbon loss is excessive.

Improved operation along the lines suggested will cut steam costs heavily. Yet this is really only the first step. Unless such a plant is of very recent design it will probably afford the progressive engineer many opportunities to reduce power costs by the installation of new equipment. Such improvements need not and usually cannot be made all at once, but can be made one step at a time over a period of years and, as a rule, without interrupting steam services. Careful study of engineering publications will keep the engineer in close touch with all that is latest and best in plant equipment and operating methods. He should develop a systematic plan of modernization so that such improved equipment as the market affords can be installed as soon as money is available, if the advantages to be gained are great enough to justify the expenditure.



"To cut steam costs, Chief, here's some of the things we've got to watch: scale and soot, bum baffling, wasted steam, poor coal, bad furnaces or settings, lousy firing or air control, wrong combustion rates."

It would be impossible to list all modernization opportunities, but the following may be noted: Higher steam pressures, superheaters, economizers, air preheaters, improved fuel-burning equipment for the new boilers, improved fuel- and ash-handling equipment, better feedwater both in quality and temperature, combustion control, boiler-house auxiliaries designed for proper heat balance as well as reliable and efficient service, the best in fittings, steam specialties and instruments.

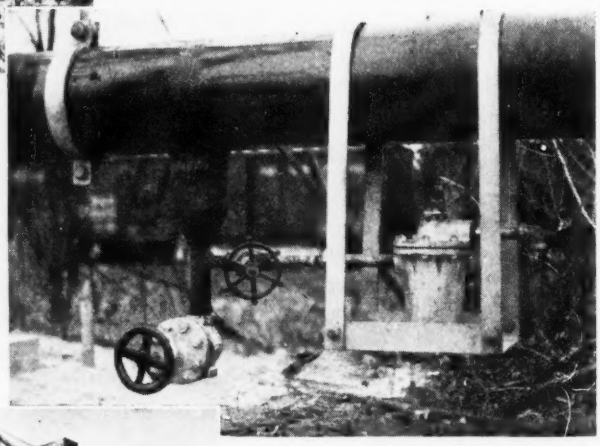
Such a plan for future development must not only be carefully prepared and considered from every angle, but each proposed improvement must be brought to the attention of the executive authority at the right time and in such a way as to receive proper consideration. Otherwise it may never see the light of day.

Every good thing, including good ideas, must be "sold."

LONGEST

All-welded 8,368-ft. process
and U. S. Industrial Chemi-
Curtis Bay, Baltimore. It
and wooden posts over high-

Above—Cutting and beveling a "Dutchman" in the line at the tail of Curtis Bay. Here the line is running along 3 ft. above ground. Insulation is 5 in. of 85% magnesia wired on in two layers and covered with waterproof felt, painted



Above—Free blow valve, drip piping and steam trap riding the line. Fifteen drips were used, necessitated by the present counterflow arrangement. Drain is from high line sections to low, plus usual gradient

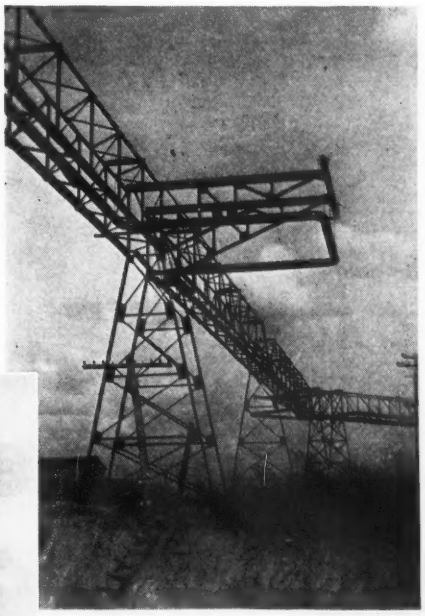
Right—After welding the line, a horizontal expansion joint interfered with access to usable ground, so was cut loose, swung to vertical and supported on an A-frame, then rewelded with an additional drip

Left—Welding in a welding elbow, one of 497 12-in. line welds. There are also sixteen 6-in. nozzle welds and numerous 1-and 2-in. welds. Expansion was taken care of by a combination of tension and compression, half the expansion being taken up by cutting pipe short and pulling up for welding

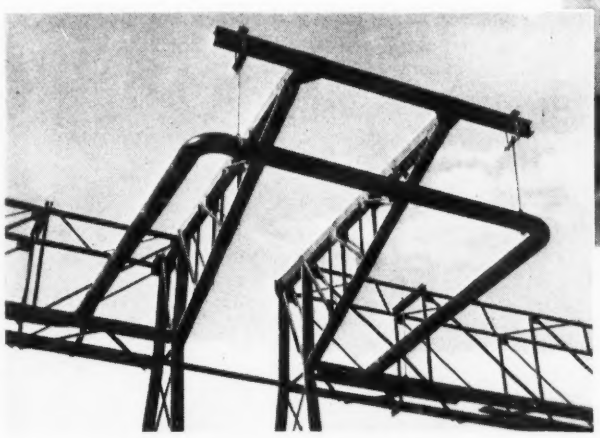
Right—A vertical expansion loop in the B & O R.R. yard, necessary to avoid taking extra space. Here the line runs just above the ground, hanging from lead-capped wooden posts and brackets

OUTDOOR 12-IN. STEAM LINE

line joins U. S. Industrial Alcohol cal plants on opposite sides of carries steam on steel structures ways, railroad and filled marsh

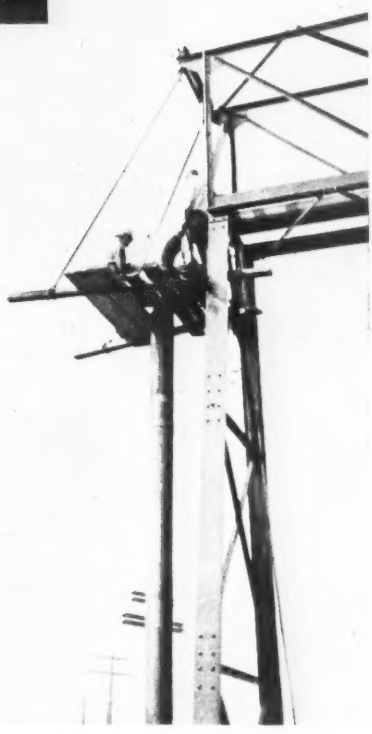


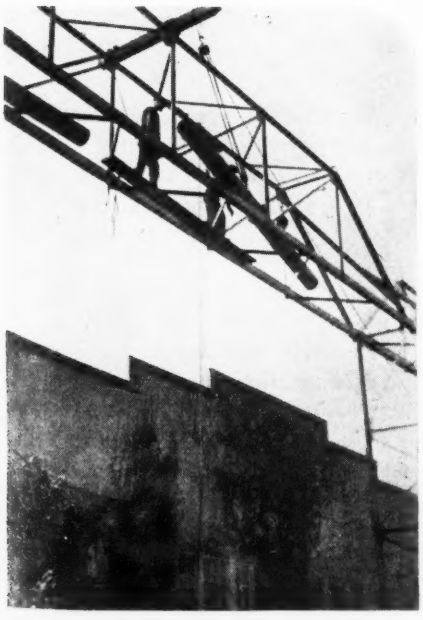
Left—Two horizontal expansion loops in the structure, showing the cantilever supports and giving some idea of the extent of some of the steel work



Above—A cantilever-type horizontal expansion bend carried on the overhead steel structure, made up of welding elbows and straight lengths of pipe

Right—A vertical weld in the structure coming out of the chemical plant. When tested after welding at full steam pressure of 150 lb., no leaks developed, even though welds like this one were made under difficult conditions 40 ft. in the air. Steam enters the line at 100 deg. superheat, leaves saturated

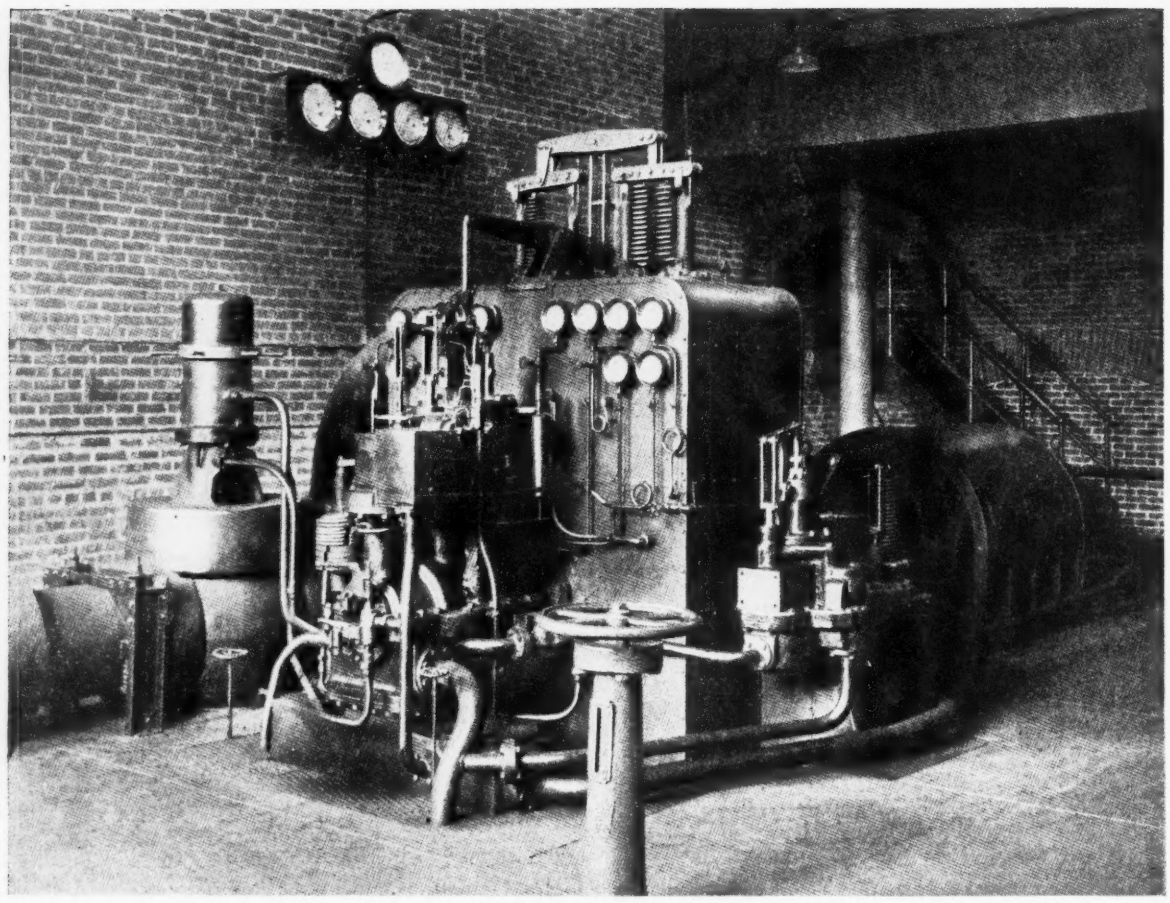




Left—Stringing pipe in the overhead structure. A small donkey engine, block and tackle, stiff-leg derrick and a "cathead" did the trick cheaply

U. S. Industrial Alcohol Co. and U. S. Industrial Chemical Co. are associated, but their plants, built in wartime, are a mile and half apart. Recent surveys have shown that one new power plant can take care of both more economically than boiler rooms at each plant. So the powerhouse at the Alcohol plant is being taken down to provide space for the new one. Meanwhile steam is being furnished by the powerhouse over at the Chemical plant. When the new powerhouse is finished, the other old one will be removed. This necessitated steam flow through the new line first in one direction, then later in the other, creating complications in draining.

Consultants—Thomas E. Murray, Inc. Welders qualified and inspection by—Air Reduction Sales Co. (A. N. Kugler of the above organization supplied these photographs.) Contractor — National Valve & Mfg. Co. Piping—Bethlehem Steel Co. Fittings—Midwest Piping & Supply Co.; Tube Turns, Inc. Valves—Walworth Co. Insulation—Philip Carey Co. Traps—H. O. Trerice Co.



1,500-kw. bleeder turbine of Kekaha Sugar Co., Ltd., Kaui, T. H.

BAGASSE TO HAWAIIAN SUGAR

VIA BLEEDER TURBINES

By J. K. Fairchild

Industrial Division (San Francisco)
Westinghouse Electric & Mfg. Co.

HAWAIIAN sugar production costs have been reduced and in many cases fuel requirements cut so that no fuel need be purchased, both by introduction of bleeder turbines during the last few years. Earlier steam-engine plants were wasteful of steam and did not provide process steam at proper temperatures or in proper quantities at given times. Primary fuel in these plants is bagasse, the crushed stalks of the sugar cane after the sugar liquor has been extracted, and the ideal arrangement would be to limit fuel requirements to the available bagasse.

One difficulty in achieving this object is the great amount of power required for pumping irrigation water on all large plantations. Further, this power demand is by no means balanced, some 218% more water being required in July and August than in January, for example. Most of this water is drawn from wells, some large plantations using over 100,000,000 gal. per day. But the results are worth the cost of irrigating, for irrigation results in an average production of 9 tons of raw sugar per acre, while unirrigated plantations get only 5.4 tons average.

In addition to the demand for power for irrigation, there is of course the demand for power to drive mill machinery and auxiliaries, and for process steam to supply the boiling house throughout the grinding.

Steam required for process usually varies between 1,100 and 1,400 lb. per ton of cane per hr. This process steam is obtained partly from the mill engines, partly from exhaust or bled steam from the power-plant prime mover. Any deficiency is made up from high-pressure steam through reducing valves.

In many plantation plants, either compound Corliss engines or turbines operating non-condensing are used. Exhaust from these prime movers is available for use in the boiling house when required, but when the mill is not grinding, their high water rate does not result in the necessary economy of bagasse fuel. To meet this situation, a mixed-pressure turbine may be designed to induct exhaust steam from the non-condensing machine at the bleed point and exhaust to a condenser, thereby making available the capacity of both old and new machines to meet peak demands.

The bleeder turbine serves not only as a reducing valve between the boiler and process steam lines, but also extracts heat from the high-pressure steam and converts it into useful work.

Power required to drive the main rolls, and therefore exhaust steam available from this source, varies considerably in the different mills, depending upon rate of grind, pressure on rolls, amount of maceration water, type of gearing, and other local conditions. Mills are usually driven by simple Corliss engines.

To present conditions illustrative of Hawaiian mill practice, results of recent studies on several irrigated plantations have been summarized in Table II.

To meet these conditions a 3,125-kva., 80% power factor, mixed-pressure turbine capable of bleeding 70,000 lb. per hr. or inducting 32,000 lb. per hr. at 8 lb. gage would provide for both process steam during boiling house operation and efficient operation of present non-condensing equipment in the power plant to carry peak irrigation loads. By carrying about 500 kw. on the non-condensing machine during periods of maximum operations, the bleeder turbine is left free to take care of load fluctuations and meet peak demands.

About 19½ to 23% of the weight of cane ground is available for use as bagasse fuel. The amount of steam that can be generated from this bagasse depends upon such factors as the heat value of the dry bagasse, per cent moisture when fired, boiler and furnace efficiency, feedwater temperature and pressure and superheat of steam generated. Heating value of dry bagasse may be taken at 8,550 B.t.u. per lb. When milled, it usually contains between 40 and 43% of moisture and when fired between 36 and 40%. Usual steam conditions do not exceed 200 lb. gage and 100 deg. superheat. Process steam is used at 5 to 10 lb. gage. Based on the above conditions, Table I shows the amount of steam that can be generated from bagasse of varying moisture content when burned at various efficiencies.

For the purpose of illustrating the balance obtainable between available bagasse fuel and that required to meet the demand for steam and electrical energy, Tables III and IV have been prepared. These tables show that under the typical conditions taken for this illustration the boiler plant will be able to generate the total required steam for the season on bagasse with a 40% moisture content.

Since 1929, five bleeder-type turbines have been purchased by sugar plantations in Hawaii:

Plantation	Maximum Kva.	Installed
Waialua Agricultural Co., Ltd.	2500	March, 1930
Kekaha Sugar Co., Ltd.	1875	Sept., 1930
Kohala Sugar Co.	1250	August, 1933
Onomea Sugar Co.	625	Fall of 1932
Ewa Plantation Co.	2500	Purchased December, 1933

Bleeder turbines installed have shown substantial savings to the plantations. The first unit, purchased by the Waialua Sugar Co. in 1929, has already shown a saving in pumping costs approximating its original selling price, and the operating results have been highly satisfactory to the plantation.

TABLE I

B.t.u. in dry bagasse—8,550. Exit gas temperature—530 deg. F. Specific heat superheated steam 0.48											
%Moisture as fired	26	28	30	32	34	36	38	40	42	44	
Total B.t.u. developed	6,236	6,058	5,884	5,711	5,548	5,385	5,221	5,048	4,875	4,711	4,5
B.t.u. loss to evaporate moisture	315	339	363	387	412	436	460	484	508	532	5
Net B.t.u. available	5,921	5,719	5,521	5,324	5,136	4,944	4,944	4,564	4,367	4,175	3,9
Evaporation from feed water at 240 deg. F. to steam at 150 lb. gage, dry and saturated											
Boiler & furnace efficiency											
80	4.80	4.64	4.48	4.33	4.18	4.01	3.86	3.71	3.54	3.39	3.
75	4.50	4.35	4.21	4.07	3.92	3.76	3.62	3.47	3.32	3.18	3.
70	4.20	4.07	3.93	3.79	3.65	3.51	3.38	3.24	3.10	2.97	2.
65	3.90	3.77	3.65	3.52	3.39	3.26	3.14	3.01	2.88	2.76	2.
60	3.60	3.48	3.37	3.25	3.13	3.01	2.90	2.78	2.66	2.54	2.
Evaporation from feedwater at 240 deg. F. to steam at 150 lb. gage, 100 deg. F. superheat											
Boiler & furnace efficiency											
80	4.57	4.38	4.23	4.08	3.93	3.78	3.64	3.50	3.34	3.20	3.
75	4.24	4.10	3.96	3.82	3.69	3.55	3.41	3.27	3.13	3.00	2.
70	3.96	3.83	3.70	3.57	3.44	3.31	3.19	3.06	2.93	2.80	2.
65	3.68	3.55	3.43	3.31	3.20	3.07	2.96	2.84	2.72	2.60	2.
60	3.39	3.28	3.17	3.06	2.95	2.84	2.73	2.62	2.51	2.40	2.

TABLE II—Conditions Typical of Hawaiian Mill Practice

AVERAGE DEMANDS:	
Average grinding rate, tons cane per hr.	80
Total grind, tons cane	450,000
Bagasse from cane, %	22
Total available bagasse, lb.	99,000
Moisture in bagasse as fired, %	40
Usual length grinding season, hr.	7,000
Actual grinding period, hr.	5,625
Process steam required per ton cane, lb. per hr.	1,300
Process steam required, lb. per hr.	104,000
Process steam from mill engine, lb. per hr.	34,000
Process steam required from power plant, lb. per hr.	70,000
Average power demand, kw.	2 200
Average power irrigation & domestic use, kw.	1,760
MAXIMUM DEMANDS:	
Grinding rate, tons per hr.	90
Process steam required, lb. per hr.	117,000
Process steam required from mill engine, lb. per hr.	38,250
Process steam required from power plant, lb. per hr.	78,750
Ratio, Average demand: Maximum demand	0.66
Maximum demand, kw.	3333
Load carried on non-condensing machine, kw.	500
Approx. water rate, n-c machine, lb. per kw.-hr.	41
Process steam from non-condensing machine, lb. per hr.	20,500
Load on bleeder turbine, kw.	2,833
Steam bleed, lb. per hr.	58,250

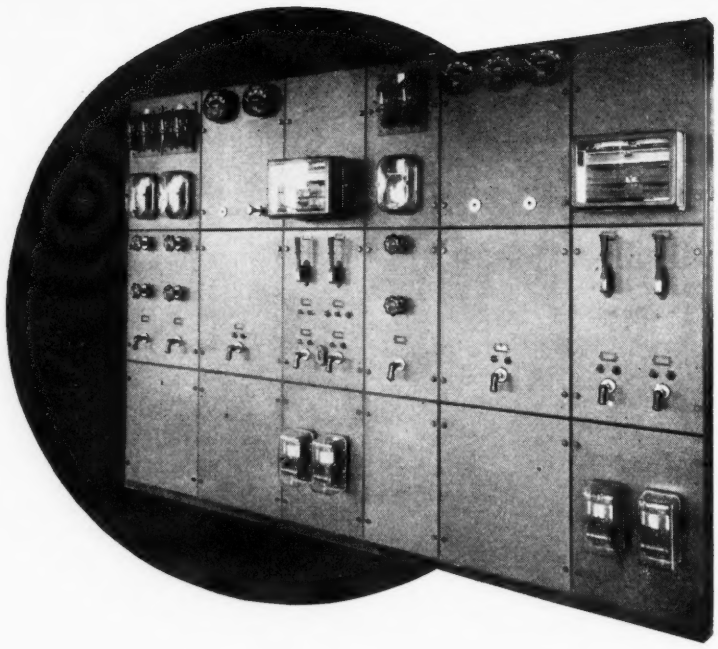
TABLE III—Typical Demand for Electrical Energy

	Kw.	Hr.	Kw.-hr.
While grinding:			
Mill	440	5625	2,477,000
Irrigation and domestic use	1760	5625	9,910,000
Total	2200	5625	12,387,000
Mill Shut Down:			
Irrigation and domestic use	1760	1375	2,420,000
Total		7000	14,807,000

TABLE IV—Energy from Bagasse Fuel

Boiler and furnace efficiency (assumed), %	75
Moisture in fuel as fired, %	40
Evaporation from feedwater at 240 deg. to steam at 150 lb. gage, dry and saturated	3.47
Total fuel available, tons	99,000
Steam from mill engine, lb. per hr.	34,000
Steam bled from m-p turbine, lb. per hr.	70,000
Steam to throttle m-p turbine, lb. per hr.	72,000
Total steam to mill and power plant, lb. per hr.	106,000
Total steam generated (7% for auxiliary use), lb. per hr.	114,000
Tons bagasse required, tons per hr.	16.43
Total bagasse during grinding period, tons	92,450
Non-grinding period:	
Average demand, kw.	1,760
Steam to throttle (approximately), lb. per hr.	28,000
Bagasse required, tons per hr.	4.34
Bagasse for 1,375 hr., tons	5,970
Total bagasse burned for season, tons	98,420
Surplus, tons	580

Proper division of load between machines and constant bus voltage are maintained by this system for d.c. generators operated in parallel



AUTOMATIC REGULATOR

Maintains

CONSTANT BUS VOLTAGE

By T. B. Montgomery, P. M. Stivender and L. A. Selleg†*

FOR d.c. motor drives in continuous-process industries, on sectional paper machines and on continuous mills in the steel industry, close speed regulation is paramount. Motor-speed regulation of approximately 0.5% or less is often necessary. This requires constant voltage at the motor terminals. Regulation of d.c. bus voltage is then vital. Large-power drives make it necessary to operate d.c. generators in parallel. For this purpose it is customary to use shunt generators, and their inherent voltage droop makes parallel operation successful.

Installations such as hot-strip mills where full load is thrown on motors one after the other as the strip enters successive rolls, cause rapidly fluctuating loads on the generator bus and require automatic regulators to maintain voltage. When individual regulators are used, a drooping-voltage characteristic must be maintained on each generator. Experience shows that to divide the current between generators satisfactorily, voltage droop must approximate 4%. Such a droop, with a load increase from zero to full value on the bus will cause a 4% drop in bus voltage. This drop makes it impossible to maintain close motor-speed regulation.

To maintain bus voltage constant and at the same time load all generators equally requires compensating means which are positive and rapid in action. The diagram shows such a compensating system applied to three standard rheostatic-type voltage regulators operating separately on d.c. generators. Each regulator consists of a main voltage coil *D* acting on a core, to which contacts are attached for controlling a motor-operated rheostat, a main compensating coil *C*, and an anti-hunting coil, not shown. The voltage coil on the regulator is connected across the armature and series winding of its generator and is therefore responsive to voltage changes at the machine's terminals. The motor-operated rheostat, not shown, is connected in the shunt field of the generator. The pull of the main compensating coil *C*, as indicated by the arrows, aids main voltage coil *D* and increases effective pull on the plunger with load increase, thus providing the necessary droop for parallel operation.

At normal voltage, no load, a weight balances regulator potential-coil pull on the plunger. Unequal load distribution between generators is caused by a voltage difference at the point of paralleling. To correct this, excitation may be reduced on the machine taking more than its share of load, or excitation may be raised on the other machine.

Compensating coil *C* on each regulator, since it aids the main voltage coil, tends to reduce excitation on load increases. Therefore, to maintain constant bus voltage it is necessary to raise excitation of the other machines if each is to take its share of the load. This is accomplished by boost-compensating coils *A* and *B* on each regulator which oppose the pull of the main voltage and droop coils *C* and tend to raise generator voltage. Coils *A* and *B* exert the same pull per volt across their terminals as do droop coils *C*. Therefore, with equal load on all machines the algebraic sum of

*Allis-Chalmers Manufacturing Co.
†Industrial Division, Westinghouse Electric & Manufacturing Co.

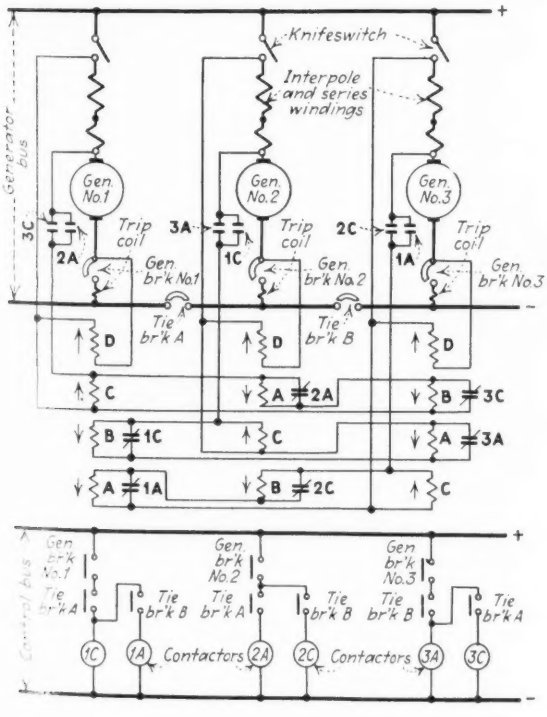
the boost- and droop-coil pulls is zero. To obtain this result under all operating conditions, the compensating circuit is made up of the droop coil *C* on one regulator connected in parallel with a boost coil on each of the other regulators in series. For example, boost coil *A* of the regulator on generator 2 is in series with boost coil *B* on regulator of generator 3 and the two are connected in parallel with droop coil *C* of the regulator for generator 1. This combination is connected across the series windings of generator 1. Similar arrangements are provided for generators 2 and 3.

With a balanced load on the machines, the regulators are in a state of equilibrium. When an unbalanced load occurs, the droop coil on the regulator for the most heavily loaded machine becomes stronger and the boost coils weaker in proportion to the load dropped by the other machines. This action causes the regulator to reduce load on the heavily loaded generator by field-rheostat adjustment. A reverse effect occurs on all other machines, since boost coils of their regulators become stronger and droop coils weaker. These regulators move to raise the voltage on their machines until equilibrium is established. Generally a $\frac{1}{3}\%$ bus-voltage change will close the regulators, moving contacts from a balanced position with either their upper or lower stationary contacts. The regulator will function to correct voltage when current unbalance between machines is about 4%.

With several generators (as in diagram) when a machine is taken out of service, its voltage regulator boost coils must also be made dead. If this is not done, the pull of the compensating coils of the regulators remaining in service would be altered. If one generator only is operating, its voltage-regulator compensating coils may be disconnected and it will hold a voltage regulation of $\frac{1}{3}\%$.

In the diagram, each generator connects to an individual bus section. Contactors 1*A*, 1*C*, 2*A*, 2*C*, 3*A* and 3*C* on the control-bus diagram, at the bottom of the figure, are of the single-pole, double-throw type.

Simplified diagram of voltage-regulator circuits



Each of these contactors short circuits a boost compensating coil on one of the regulators when in the de-energized position. When energized, these contactors connect their respective boost compensating coils into the proper circuit and connect the droop compensating coils when their particular machine is connected in parallel with others. Any of the generators may be operated with both tie breakers closed to energize the whole bus. Under this condition, no compensating coils will be energized in any regulator circuit. The photograph shows the voltage regulator control elements installed with control switches and compensating adjusting rheostat controls on panels 1 and 4, reading from left to right.

The regulating system can be applied to almost any practical combination of generators connected to a bus arranged to accommodate load requirements best. Load may be distributed between several bus sections as best suits operating requirements. This control may be applied to any standard regulator without essential change in design. Any convenient source of potential drop which is proportional to the load, such as is required with all standard regulators, may be used to operate the compensating coils. The source of voltage drop may be a shunt or the interpole or compensating windings of a machine with commercial manufacturing tolerances. Small adjustable resistances are desirable in each coil circuit to provide proper balancing. It is also very desirable that sufficiently large conductors be used so that generator-lead resistance is negligible.

Silvered conducting surfaces are used on the contactors for the several operating combinations to prevent variations in contact drops. Very satisfactory results have been obtained, however, without this precaution.

Kilowatt Boilers?

RATINGS and outputs in "boiler horsepower" are gradually becoming obsolete. New boilers are generally sold as 100,000-lb. units or 50,000-lb. units. When we want to talk about square feet of heating surface (as is every engineer's right) we say "square feet"; we don't divide by ten and misname the result "horsepower." This is definite progress.

Now some urge that we go a step further and express the rating and actual steam output of boilers in kilowatts (3412 B.t.u. per hour equals 1 kw.). Turbine-room efficiency would be simple, merely the net kilowatt output divided by the net kilowatt input of steam.

Looks easy, but there are real objections. Would we express fuel values also in kilowatts to make boiler-room efficiency easy to figure? How about steam delivered to process? How about rerating all factory heat transfer and heat-using equipment in terms of kilowatts? How about introducing a disturbing factor into simple water-heating computations? More complexity, instead of less.

All in all, the change to the kilowatt as the single measure of heat and electrical energy would seem premature, although it may come some day. And the change for the boiler alone would get us nowhere.

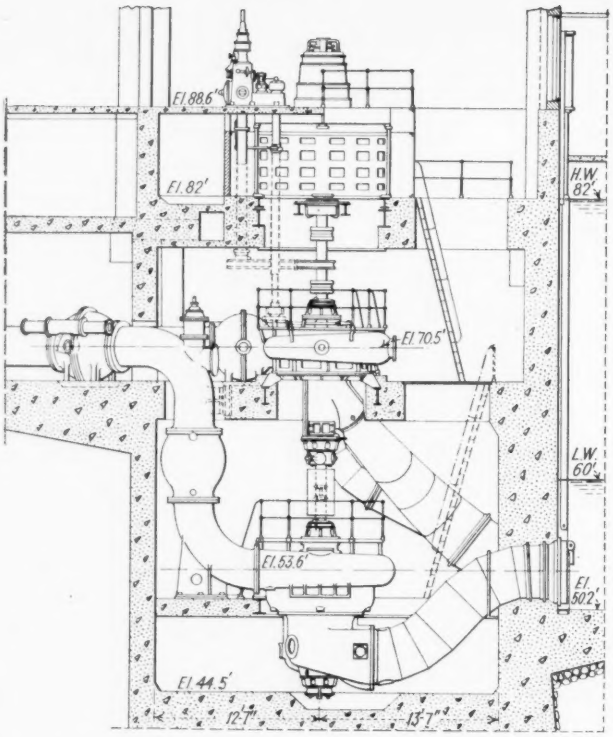


Fig. 1—Elevation through power house showing alternator, turbine and pump coupled together

SWEDEN BUILDS

By George Willock

Engineer, Trollhättan, Sweden

SILLRE, on the Indal River, 40 mi. up river from the Gulf of Bothnia, is one of a chain of hydro-electric installations owned and operated by the Royal Board of Water Falls. This plant is not only the first pumped-storage plant, but utilizes a higher head than any previously developed in Sweden. Sillre operates in combination with Norrfors hydro-electric system of 22,000-kw. capacity on Umea River, 150 mi. north of Sillre. A reservoir cannot be created at Norrfors, therefore it is not possible to regulate river flow to suit power demands.

Surplus power during week-ends and other off-peak periods is transmitted to Sillre to pump water to a storage reservoir 640 ft. above river level, whereby an additional 5,000,000 kw.-hr. is obtained for peak service. This reservoir has a useful storage capacity of 706,000,000 cu.ft., which, with three other reservoirs on the river, brings total storage capacity to 1,380,000,000 cu.ft., equivalent to the total dry-year flow of the river.

Water is brought to the power house through an unlined tunnel 7,500 ft. long and of 176.6 sq.ft. cross-section and a penstock 3,051 ft. long by 6 ft. diameter. A surge tank is installed between tunnel and penstock. The power-house is designed for three units, but only one, rated 6,000 kw., has been installed. The other two, Nos. 1 and 3, will be designed for 2,500- and 8,000-kw. capacity. No. 1 unit will not include a pump.

The pump, Fig. 5, is a 2-stage centrifugal type, with a capacity of 30,000 to 45,000 g.p.m. against a head of 745 to 600 ft. at a speed of 600 r.p.m. The cast bronze impellers have an inlet diameter of 32 in., outlet diameter of 57 in., and width at the outlet of 4.8 in. Guide-rings and vanes are also bronze, and the spiral casing is a one-piece steel casting. Water from the intake flows through the lower part of the casing to the lower impeller, then to the upper part of the casing and to the penstock.

The turbine, rated 8,600 hp. under 390-ft. head at 600 r.p.m., will develop 10,080 hp. under a maximum head of 656 ft. With 19 vanes of cast bronze, the runner has an inlet diameter of 49.2 in. and an outlet diameter of 35.4 in.

Sixteen wicket gates of cast steel are each supported on a bronze ring to reduce power required for regulation. Each gate and its spindles are cast in one piece and project through stuffing boxes in the crown-plate for connection by levers and links to a regulating ring. Surfaces of gate equipment adjacent to flow and runner are provided with renewable bronze liners.

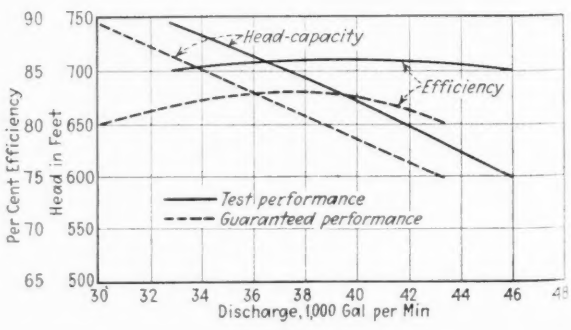
The 3-phase alternator rated at 7,000 kva., 0.70 power factor, 6.6 kva., 50 cycles has a direct-coupled exciter. When operating as a motor, its output is 7,000 kw. at unit power factor.

Two guide-bearings and a thrust bearing support the rotor. The latter bearing, a segment type, is carried on the upper spider. The 44.3-ft. shaft is rather exceptional for a unit of 7,000-kva. rating, being held in six guide bearings. Thrust and guide bearings are lubricated by circulated and cooled oil. The thrust-bearing oil reservoir provides for water-cooling but can operate for one hour without oil circulation and cooling water.

The rotor can be brought to standstill by four hydraulic brakes on the lower bearing spider acting against the lower flywheel ring on the rotor. These brakes are actuated by a hand pump adjacent to the alternator, which will also give high pressure to lift rotating parts 1.18 in. for thrust-bearing inspection.

The rotor, designed to stand a runaway speed of 1,175 r.p.m. for 3 min., will operate backwards for 30 min. at 1,000 r.p.m. without injury to the bearings. The latter may occur if power to the motor fails during pumping and water pressure drives the pump as a

Fig. 2—Pump efficiency and head-capacity



A PUMPED-STORAGE PLANT

Sillre goes into operation with one unit comprising an alternator, 10,000-hp. turbine and a 2-stage pump for 656-ft. head, all connected on one vertical shaft

turbine. Safety devices, however, close the pump discharge outlet valve in such an emergency.

In addition to the governor, the unit has a pressure regulator, which functions only when load is dropped. It opens and bypasses water rejected by the turbine. When gates are adjusted to the new load conditions, it automatically reduces penstock flow to that required by the turbine.

Tests show the guarantees are more than fulfilled. Water was measured by nine current meters, carried by a cross-piece, in the penstock 141 ft. downstream from the surge chamber. Current meters pointed downstream during the pump test, upstream during the turbine test. Readings were taken every 3 or 4 min.

The curves, Fig. 2, give pump test results. A maximum efficiency of 86% was obtained with a discharge of 41,200 g.p.m. against 656-ft. head. For this head, the guarantee was 38,000 g.p.m. and an efficiency of 83%. Test performance exceeded guarantees at all points by a large margin. Pressure rise in the penstock when power was suddenly cut off from the pump was only 88.6 ft., against a guarantee of not more than 164 ft.

Fig. 3 gives test and guaranteed efficiencies for the waterwheel at 554 and 656-ft. head. A maximum efficiency of 91.6 per cent was obtained at about 0.9 rated load and 554-ft. head, guaranteed efficiency for these conditions being 87.5 per cent. As with the pump, turbine test efficiencies exceeded guarantees by a good margin. When 7,000-kw. load was suddenly dropped, the speed rise reached 30 per cent, the performance guaranteed for the governor. At less than full load, governor performance was slightly better than guaranteed. Pressure rise in the penstock with full-load rejection, guaranteed not to exceed 65.6 ft., was not exceeded.

Contractors who supplied the machinery are: Pump, turbine, governor and valves with distribution-pipe, Nydqvist & Holm A/B, Trollhättan; electrical equipment, Asea Electric Ltd., Västerås.

Fig. 3—Turbine efficiency curves

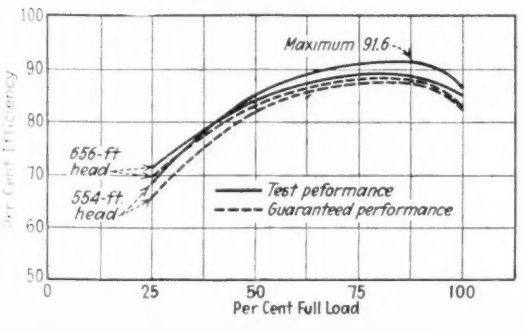


Fig. 4—Vertical cross-section through turbine

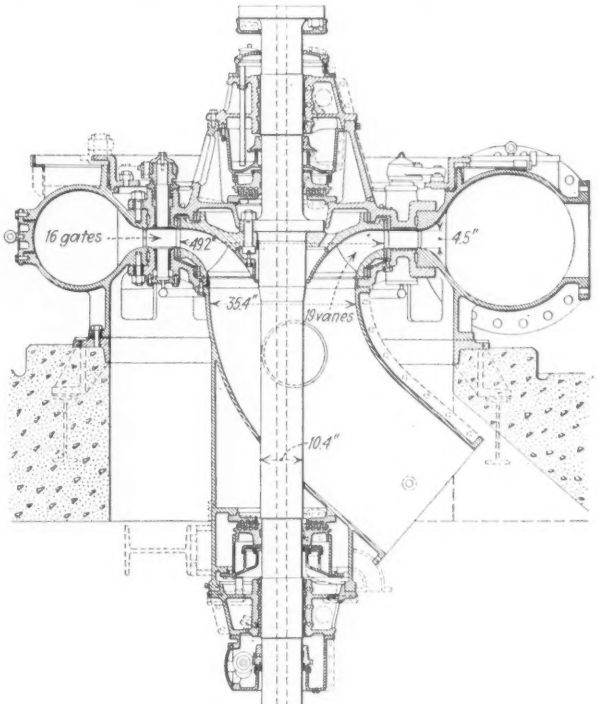
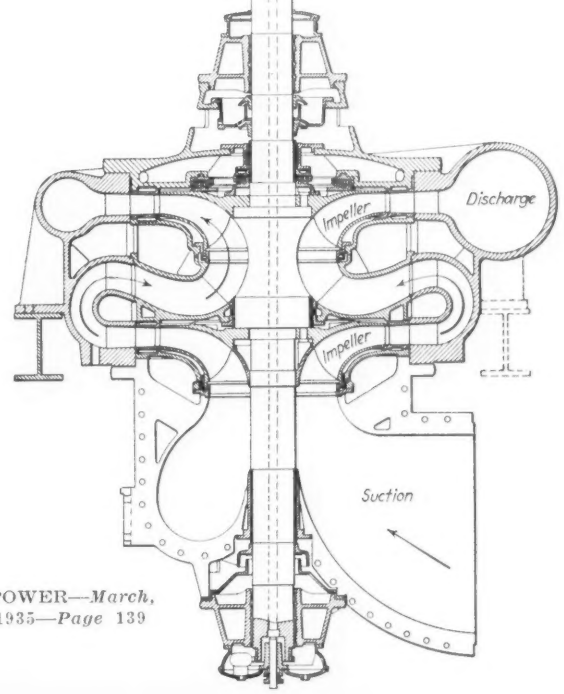


Fig. 5—Vertical cross-section through pump



AIR WASHERS PROVIDE MOISTURE TO ORDER

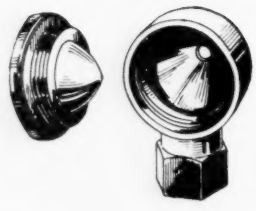
By R. B. Purdy
Associate Editor

Continuing the series of articles on air-conditioning simplified, this third article discusses air washer performance, types, and applications. Earlier articles appeared in November, 1934, and February, 1935

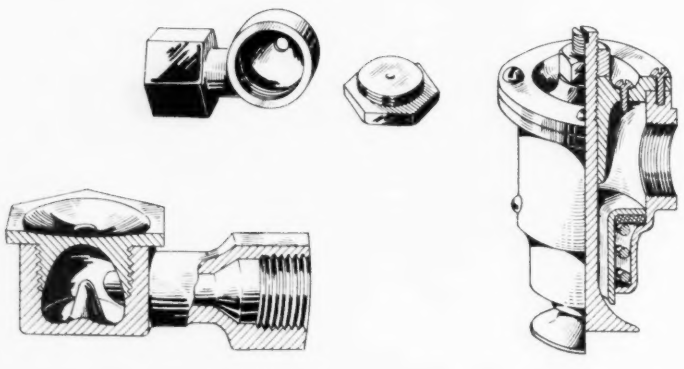
HUMIDIFYING or dehumidifying, cooling and cleaning the air are the vitally important functions in air-conditioning. Therefore, the air washer may well be looked upon as the heart of an air-conditioning system, for it performs these functions. Unless it is selected and operated properly, the system itself will not be satisfactory.

Air washers are used not only in almost every central air-conditioning plant, but also in many smaller unit air conditioners. In central systems the air washers used consist of a spray system arranged above a tank in which the spray water is caught as it falls, a system of eliminator plates to prevent air from carrying spray water out of the washer and into the connecting duct, and a galvanized iron or copper sheet metal housing.

Spray is produced by brass nozzles at the ends of branch nipples attached to vertical galvanized pipe risers. These risers are supported on a bottom header and fastened in various ways at their tops to hold them rigid. In some washers, the nozzles are staggered on each side of the risers, while in other washers the nozzles are arranged in pairs. The height and number of risers depends upon the capacity of the air washer, and the shape required by a particular installation. Depending upon requirements, there may be one, two or more stands of spray nozzles. Nozzles in the first spray bank usually spray in the direction of air flow, while those in the second and following banks spray into or against the air stream. This arrangement permits the first bank to be placed close to the air washer entrance, and thus make the washer somewhat shorter. If both banks spray against air flow the cooling effect is greater.



Typical nozzles used in air washers. Three types of centrifugal nozzles are shown and one flushing type (below) which is of particular value when there is considerable dirt in the water



Nozzles Should Produce Fine Spray

For good performance, the nozzles must produce a fine spray or mist which gives the maximum water surface for the air to contact. The ideal arrangement is for spray to cover the entire flow area of the washer, so that all air must pass through sprayed water.

Nozzles are usually designed for operation at pressures between 20 to 25 lb. At this pressure the centrifugal type nozzle will discharge about $1\frac{1}{2}$ to 2 gal. of water a minute.

Centrifugal nozzles are made by various manufacturers, but differ only slightly in general appearance. Typical nozzles are shown below. All are arranged to impart a whirling motion to the water before it issues through the nozzle orifice. Several manufacturers make "flushing nozzles," arranged so that the restricted area of the nozzle may be increased at will to permit greater water flow to carry out any dirt that may have collected in the nozzle and thus prevent nozzle clogging. In these the water issues from an annular orifice and impinges upon a conical deflector which forms the spray. The deflector may be moved away from the nozzle body to increase the flow area. One valve of this type is flushed by operating a central valve which supplies water to a diaphragm that operates a deflector disk. The valve illustrated is arranged so that it automatically flushes each time the spray water is turned on.

Eliminators on most air washers are likewise of the same general design. They consist of a series of vertical galvanized-iron or copper plates placed $1\frac{1}{8}$ to $2\frac{1}{4}$ in. apart, and formed so that they present to air flow, five or six surfaces at an angle of 30 to 45 deg. as shown at right. The greater the angle of the plate the wider the spacing between them and the greater the frictional resistance. The greater angle, however, makes a shorter and less costly eliminator. The last two or three deflectors have projecting lips which form gutters to catch the water removed from the air by the plates.

Eliminator plates are usually held in place by notched angles, and some arrangement is usually provided so that they may be taken out easily for painting, repairing or replacement, in case of corrosion. Often flushing nozzles are provided to flood the eliminator plates and keep them clean. These nozzles are also used when the main spray is shut down to wash the air and cool to 20 to 25% of the wet-bulb depression.

The dust and dirt particles carried in with the air are wet by the water spray and are then removed by the eliminator plates to which they stick. Cleaning efficiency of an air washer, therefore, depends upon the amount of eliminator surface provided.

Table I—Typical Air Friction Through Air Washer, Inches of Water

Face Air Velocity, ft. per min.	G.P.M. per sq.ft. per spray bank			
	2	3	4	6
200	0.14	0.18	0.20	0.30
400	0.35	0.39	0.41	0.51
500	0.45	0.49	0.50	0.61
650	0.68	0.72	0.74	0.84
750	0.86	0.90	0.92	1.02
	For each added spray bank add			
In. water	0.03	0.05	0.06	0.11

Air distributor plates are often placed in the washer inlet to distribute entering air evenly. Some of these are simply plates punched full of holes; others are diffuser vanes.

Air Washer Performance

In ventilation work air washers are used to clean the air and to provide some degree of cooling by evaporation of some of the refrigerated spray water, as described in the article, "It Ain't the Heat—It's the Humidity," in February *Power*. Washers used for this purpose usually have only one bank of spray nozzles, because it is not desirable to saturate the air completely. Such washers will cool air to 60 or 70% of the entering wet-bulb depression, depending upon air velocity, spray-water pressure and wet-bulb depression. Water required by the main spray usually amounts to 3.5 to 5.5 g.p.m. per 1,000 cu.ft. of air. If flooding nozzles are used in addition, requirements are from 4 to 8 g.p.m. per 1,000 cu.ft.

Table II—Temperature Difference Between Leaving Air and Leaving Water Two Spray Banks

G.P.M. per sq.ft. per bank	Face Velocity, ft. per min.				
	200	400	500	650	750
2	0	0	2	4.5	6.5
3	0	0	0	1.0	3.0
4	0	0	0	0	1.5
6	0	0	0	0	1.5

Air washers are usually designed for an air velocity of 500 ft. per min. If higher velocities are employed the cooling efficiency of the water will decrease and frictional resistance will increase. In some washers velocities 10% above the design value will result in entrained moisture being carried past the eliminator plates. Other designs permit velocities of 750 to 900 without moisture being carried past the eliminator. Lower velocities than those for which the washer is designed will cause the air to be cooled more nearly to the entering wet-bulb temperature. At velocities below 200 ft. per min. the eliminator plates do not properly remove unevaporated moisture. Typical frictional resistance to air flow is shown in Table I.

For comfort air-conditioning, when refrigerated water is used, washers with two banks of sprays are usually selected. These will cool the air to within 1 to 2 deg. of spray-water temperature. Variations of cooling efficiency with 2-bank washers, with changes in air velocity and water supply are shown in Table II.

Special Air Washers

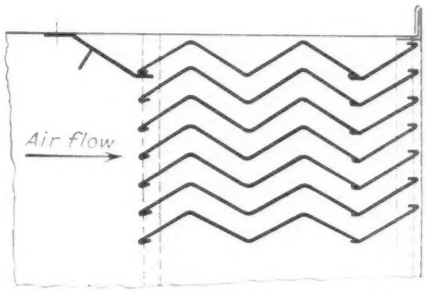
With refrigerated water, a washer operates as a dehumidifier, since the air is cooled below the entering dew point, and thus some of its water vapor is condensed out. Spray-water temperature should therefore be controlled to 1 to 2 deg. below the desired leaving dewpoint.

In special cases, for example, when a limited supply of cold well water is available, 2-stage washers may be used to advantage. Well water is pumped through the two spray systems in series, so that entering air is cooled first by the warmer water and finally by the cold water fresh from the well. This 2-stage counterflow arrangement gives maximum cooling with minimum water.

Sometimes baudelot coolers are incorporated in the air washer to cool spray water. Fire regulations in many cities, however, do not permit this method of cooling in public buildings. In such cases, refrigerated water is pumped to the washer from the refrigerator equipment.

Air washers, even when using refrigerated water, usually are provided with their own recirculating spray pumps. These pumps take their suction from the air-washer tank through a strainer, and also from the cold-water supply line. A dewpoint thermostat in the discharge duct controls the amount of cold water delivered to the spray pump suction, and mixed with the recirculated spray water. Overflow water is piped back to the refrigerating system. Provisions must also be made for heating spray water during winter operation when a certain amount of humidification is desirable.

Information for this article was obtained from American Blower Co., Buffalo Forge Co., B. F. Sturtevant Co., and York Ice Machinery Corp.



Eliminators at the air washer exit remove unevaporated moisture

READERS ARGUE THE

POWER FALLACIES

They agree and disagree with the views expressed on Page 19 of January *Power*

PAGE 19, January *Power,* presented six "Power Fallacies," things commonly believed but, in the editor's opinion, not true. He said "why" and invited discussion. Here is some of the comeback.

Disagrees on Investment

IN YOUR discussion of "Power Fallacy Number 4," I find that I must take some exception to the last paragraph, which reads: "The new equipment is good investment if the saving in operating cost will yield an adequate return on the new investment."

The terms "operating cost" and "adequate return" probably need some definition. My impression is that the rule might be better stated as follows: "The new equipment is a good investment if the over-all annual costs, including principal payments, interest, operation and maintenance, are less than similar payments on the existing equipment."

If the above-mentioned over-all charges of a commodity, such as kilowatt-hours, are greater in the case of new equipment, then the new equipment would not be a good investment.

I am assuming, of course, that the existing equipment is in good operating condition and not approaching the demolishing point.

Portland, Ore. D. F. MCCURRACH
Northwestern Electric Co.

If I understand Mr. McCurrach correctly, I am forced to disagree. Assume interest and principal payments to be $1,000 per yr. for either the old or the new equipment. Assume also that the running of the old equipment takes $1,000 per yr., and the new $900 per yr. (including maintenance).

Then, by Mr. McCurrach's definition, it would presumably pay to install the new equipment. Yet, actually, the present total yearly expenditure is $1,000 fixed charges + $1,000 operation = $2,000 per yr. If the new equipment is installed, the actual yearly payments will be $900 for operation + $1,000 for fixed charges on new equipment + another $1,000 for fixed charges on the old. This gives a total of $2900, corresponding to a yearly net loss of $900. I add in fixed charges on the old equipment because they would continue until the debt had been discharged, regardless of whether the equipment had been discarded.—Editor.

Process Steam Pressure

I AGREE with the Editor on the first five statements. Fallacy No. 6, "High-pressure steam is much better for process use because it contains a lot more heat," leaves room for considerable discussion. As written, this statement is a fallacy. However, in any discussion of process-steam pressures, the all-important factor of steam temperature cannot be ignored.

The application of steam to industrial processes generally involves heat transfer surface. All other factors being equal, the extent of this surface required for a given process operation varies inversely as the mean temperature difference between the steam and the material being processed.

Even though the heat content of saturated steam at low pressure is very little less than at high pressures, there is a wide variation in temperature. Higher pressure steam allows a considerable reduction in the amount of heat-transfer surface.

Inasmuch as process heat transfer surface costs money, the selection of process steam pressures involves balancing the savings from the better heat balance with low exhaust or bleeder pressure against the higher fixed charges incidental to the distribution and use of low-pressure steam.

Waynesboro, Va. S. H. COLEMAN

[I agree with Mr. Coleman on every point.—Editor]

Agrees With No. 6

WITH reference to your "Fallacy No. 6," it is agreed that your statement of fallacy is correct. Discussing it, you state: "If the steam were supplied directly from the boiler in both cases, a lower process pressure would make no change in fuel consumption one way or the other."

Let us imagine a plant which generates 1,000,000 lb. of steam each 24 hr., at 125 lb. pressure, using 14,000-B.t.u. coal with an average evaporation of 8.5 lb., and no condensate return. Feedwater is heated to 200 deg. by exhaust from auxiliaries.

Assuming this plant to be operating at 30 lb. gage, each pound of steam contains

1,172 B.t.u.
less 168 B.t.u. in feedwater at 200 deg.
equals 1,004 B.t.u. added to produce 1 lb. of steam.

Washing-machine operators open wide the valves, whether they are using steam at 30 lb. or 125 lb. pressure, and no more steam is required at low pressure than at high pressure. By using steam at 30 lb., there would therefore be a saving of 1,024—1,004 or 20 B.t.u. per lb. of steam, or 20,000,000 B.t.u. daily. Requiring 2,300 lb. of coal.

Detroit, Mich. CHARLES PARKINSON

[Mr. Parkinson assumes that, since valves are always wide open, the operators would use the same amount of steam in either case. It seems that this assumption is not warranted, although it would be hard, in practice, to measure a difference as small as 2.4%.—Editor]

THE LOWDOWN ON SPRAYED METAL COATINGS

A USER and two contract shop men led discussion on "Experiences in the Application of Sprayed Metal Coatings," of the Power Division, A.S.M.E., in the Engineering Societies Building, New York, Feb. 6. F. M. Gibson, plant engineer, American Sugar Refinery Co., acted as chairman.

James W. Gibbons, assistant plant engineer, Brooklyn refinery, American Sugar Refining Co., described his extensive experience with the process. Difficulties have resulted primarily from the extreme adhesiveness of sugar in process and the unusual character of the East River water which is used for condensing and cooling. Sprayed lead appears best to resist this corrosion, provided the base metal has been properly pre- All joint surfaces *must* be cleaned and filled before spraying. Joints under expansion and contraction are filled by welding; crevices with putty or Smooth-On.

Mr. Gibbons stressed the importance of having continuous air pressure. Since their processes require a considerable amount of air, pressure in the compressed-air supply lines may suddenly drop as much as 10 lb. When a drop occurred, molten metal was solidified in the nozzle, necessitating a $100 replacement.

Phosphor Bronze on Pumps

Phosphor bronze has been applied successfully up to 1¼ in. thick on salt-water pumps to fill pits and build up worn surfaces, the principal precaution being to keep the spray gun well away from the job in order to avoid burning the bronze. Zinc is applied first to the clean cast-iron surface, then the bronze over the zinc. If the bronze temperature is allowed to get too high, the coating will lift from the base.

Customary methods of filling pits and low spots by spraying through a templet are not satisfactory because the spray coating has a tendency to bridge over instead of filling. Instead, Mr. Gibbons simply directs the gun at the lowest spot, filling small areas at a time. He chips out graphitic pockets and threads rough-finished studs into them to act as keyfasts for the sprayed coating. On cast-iron pump impellers, Mr. Gibbons found it necessary to spray on low-carbon steel first, and then high-carbon, in order to get a wear-resisting surface.

It was Mr. Gibbons' experience that sand blast is better than a steel-grit blast in preparing a surface, because the grit cuts too deep and gives a rough job. Further, loose grit gets into the metal being sprayed and produces rust spots under the corrosive action of the sugar liquor. Rough surfaces also cause trouble because hot sugar, being compressed into cubes, is so strong and adhesive that if rust spots offer an opportunity it will lift the coating from the base metal.

In discussion, Mr. Gibson mentioned that much harm has been done the process by metal-spraying contractors who have submitted samples which are not suitable for the particular conditions for which metal spray is being considered. His company's first gun worked so successfully that he has just ordered a second one. He found that the best paint available for sugar-liquor tanks would last 1½ yr., while a metal spray coating put on over two years ago is as good as when applied.

Spraying Combustion Chambers

Maurice Hallen, president of Hallen Welding Service, Inc., described several recent advances in spraying combustion chambers of internal-combustion engines with aluminum. Apparently such spraying has the advantage of slowing combustion, gives up heat to gases during compression thus lowering skin temperature as well as avoiding pre-ignition and slowing carbon formation within the cylinder. His company has also sprayed valve tops with aluminum, lowering operating temperature of the top about 100 deg. C., decidedly reducing burning. This company has also sprayed collector rings, exhaust valves, etc. The aluminum is used over sheet steel, thus keeping weight down but doubling life over the plain sheet.

Several years ago Mr. Hallen zinc-lined a water tank exposed to decided temperature changes, plus ice formation and erosion from ice in winter. He found it necessary to weld all joints and rivet heads to get unbroken surface for the spray. Both sand-blast and grit-blast were used in preparation, but it was too difficult to clean the bitumastic dust (previous coating) from the steel grit. It is Mr. Hallen's opinion that generally sand is better than steel grit for blasting, because it can be used longer, and when discarded costs less, as well as being less harmful to operators.

Mr. Hallen has also rebuilt many crankshafts simply by roughing up the bearing surface, applying low-carbon steel and later high-carbon, the thickness of coat being about 0.035 to 0.040 in. on the radius.

Mr. Hallen has also used cadmium to resist salt-water corrosion, with considerable success.

William H. McMakin, spray engineer of the Brody System, Inc., differed with the two preceding speakers, in that it is his opinion that No. 20 or 30 angular steel grit gives a better bond for spray coating, particularly if it is for heavy-duty service. He emphasized that it is better if the surface is rough-machined first.

In answer to a question regarding closing of pores, Mr. McMakin said that several methods are available. One is to preheat a surface to 200 deg. C., if tin or lead is being sprayed or to 400 deg. C. if copper is being sprayed. Another is to scratch-brush between coats. Still another is to varnish or paint the sprayed coating. Another is to spray on lead, the sulphate or

Drawing Courtesy Air Reduction Sales Co.

carbonate formed will close the pores. In his experience, mechanical brushing and buffing seems best.

In order to get a smooth finish on a casting, Mr. McMakin grinds the casting first, then blasts with heavy grit and low pressure (50 to 60 lb.). He has also sprayed stainless directly on cast iron as much as $\frac{1}{32}$ in. thick. This can afterward be ground down, starting with a 24- or 16-emery to cut the coating, and finished with 60-, 80- or 120-emery to get a smooth finish. On aluminum castings the worst holes must be soldered up first with aluminum. Then the piece is blasted as with stainless procedure. Aluminum is sprayed on $\frac{1}{32}$-in. thick and ground with 60-emery and wax on the wheel, then finished with 120-180, or even 250-emery and buffed. This will give a mirror surface.

The highest high-carbon steel Mr. McMakin has been able to spray successfully is 1.2% carbon, which gives a hardness of 68-74 scleroscope. Scleroscope measurement, normally considered inaccurate, is used instead of Brinell on sprayed coatings because Brinell will vary widely due to the tensile stress set up around the rim of the depression when the ball is pressed in. This company uses Ascoloy (steel with 10 to 12% chromium and low carbon) to fill holes in castings and not show when the piece is finished.

Discussion

In discussion, Mr. Hall, operating superintendent of Hell Gate Station, explained that his company has sprayed shafts successfully. However, on a cinder catcher operating at 300 deg. F., and open to salt-water spray occasionally, metal spray has not so far proven successful. One-thirty-second up to $\frac{1}{16}$-in. lead was used on the entrance edge of division plates, to avoid erosion, but after short service it began to peel off. This company has also used the process in spraying zinc on column footings on a coal dock which is washed down occasionally with salt water. These column footings were sprayed last year, and so far have been entirely satisfactory.

Mr. McMakin explained that too much heat, improper surface preparation, or not enough base coating over the steel will cause blistering due to the penetration of the corrosive through the coating and creation of iron oxide inside, which causes bulging. Mr. Gibbons also gave a word of warning in regard to use of small-diameter aluminum wire of sizes recommended by manufacturers, saying that larger diameter wire should be used because it has less tendency to clog the gun.

Another discussor brought out that in the B.M.T. power plant, stainless steel has been applied directly on the stationary low-pressure steam-turbine blades with entire success.

Some discussion was carried on with regard to lead versus zinc for resistance to salt water. Mr. Axline, of Metallizing Co. of America, has found zinc better on large surfaces, provided it can be covered with a paint or varnish, and it is applied on steel. Mr. Gibbons has had no success in applying zinc on brass intake screens, but attributes his failure to the East River water, which is high in sulphates and sewage.

Litchfield's Power

By Charles Foster

Consulting Engineer, Duluth, Minn.

LITCHFIELD, Minn., has had its own light, power, heat and water utility for the past 35 years, beginning with two 75-kw., a.c., belted generators and two H.R.T. boilers. A 150-kw. steam-engine-driven belted generator was added, followed in 1915 by an Erie Ball 4-valve steam engine direct-connected to a 250-kw., 3-phase, 60-cycle, a.c. set. At that time the steam plant consisted of three, 1,500-sq.ft., H.R.T. boilers.

In 1922, load had grown so steadily that complete remodeling was necessary plus an addition to capacity. A 400-kw. Nordberg uniflow engine direct-connected to a G.E. generator and a 3,000-sq.ft. Kidwell water-tube boiler with Taylor multiple-retort underfeed stoker were accordingly added in a new building.

By this time, the municipality was supplying power to its water works and selling exhaust steam to various buildings in Litchfield. Steam heat requirements grew so rapidly that in 1925 a 4,000-sq.ft. Badenhausen water-tube boiler with Taylor multiple-retort underfeed stoker replaced the H.R.T. boilers, and both old and new boilers were equipped with Hagan combustion control equipment, Republic flowmeters and CO_2 recorders.

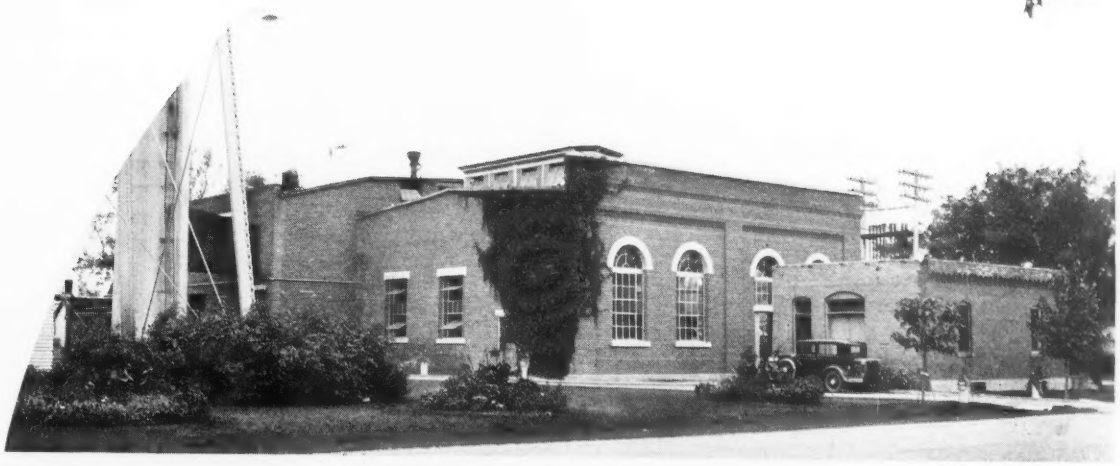
Load was added from nearby cities and farms until in 1931 additional generating equipment was again required. Due to the large steam heating load, the consulting engineer selected a 750-kw. Westinghouse bleeder-type turbine-generator with a cooling tower. 1933 found electrical load jumping, but steam load holding stationary. The small boiler could not handle both steam and electrical loads, so it was necessary to use the large boiler continuously during the winter.

I made an investigation. Two alternatives were possible: Install a new boiler and add a turbine-generator later, total investment $90,000. Install a diesel-generator for summer economy and steam standby in winter, initial investment $60,000. Further study showed that even with the large boiler off the line, the small boiler could handle the steam load and the diesel the electrical load in winter, so a 606-kw. (875-hp.) Fairbanks-Morse diesel with Woodward governor was added. At the same time a 400-g.p.m., electric-motor-driven, F. M. turbine pump was installed in a new well.

While the installation has been operating for too short a time to give conclusive data, present costs indicate that fuel cost per kw.-hr., including coal for keeping one boiler under steam for emergency, is about 4 mills.

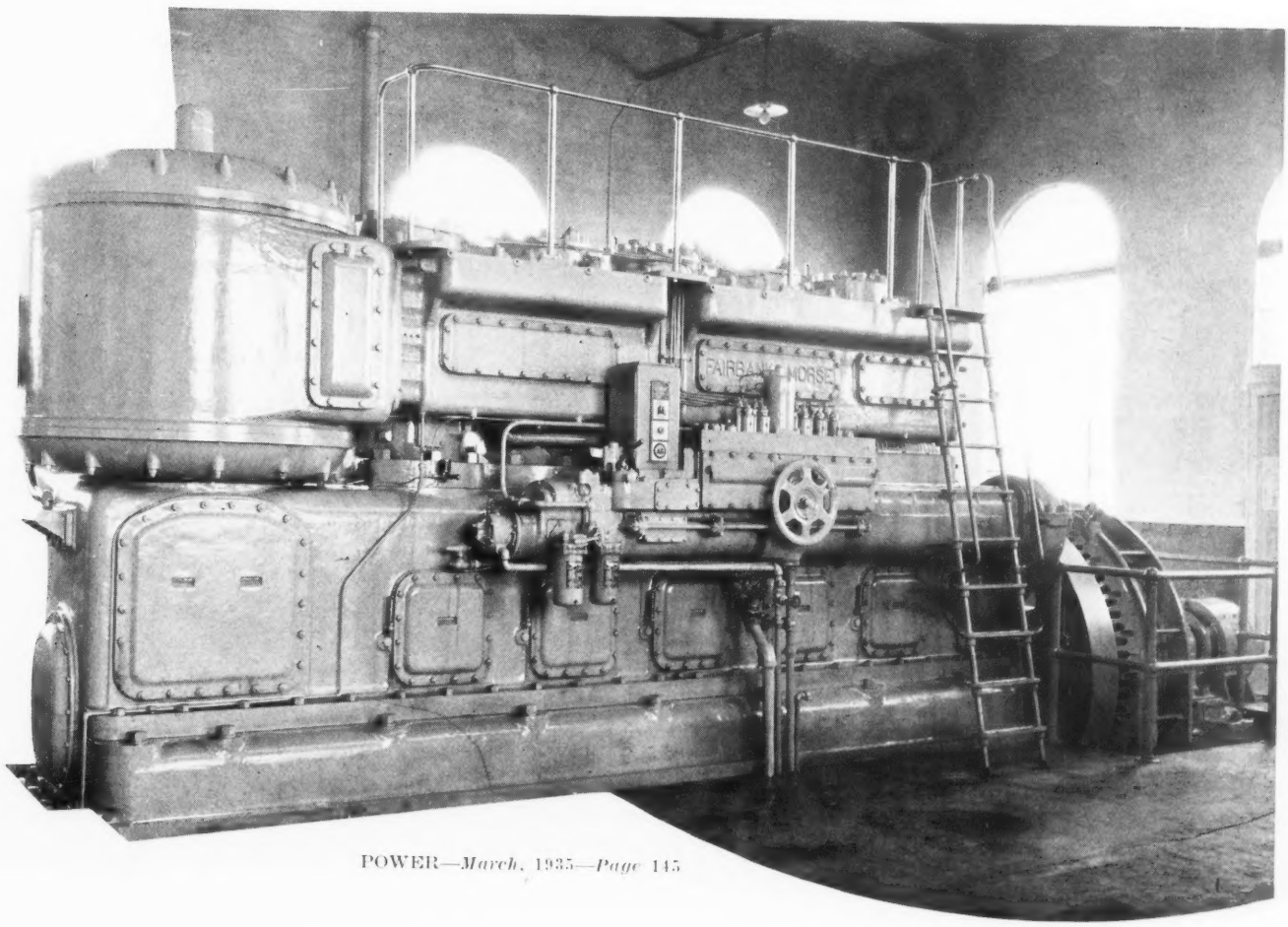
All additions have been paid for out of earnings, with lower rate schedules than any other municipality in the state. Heat balance of the plant is very good. Summer operation of the diesel alone saves about 5 mills per kw.-hr. over steam-turbine condensing operation, an annual operating saving of $9,000 (a portion due to high auxiliary losses of steam turbine under variable load conditions).

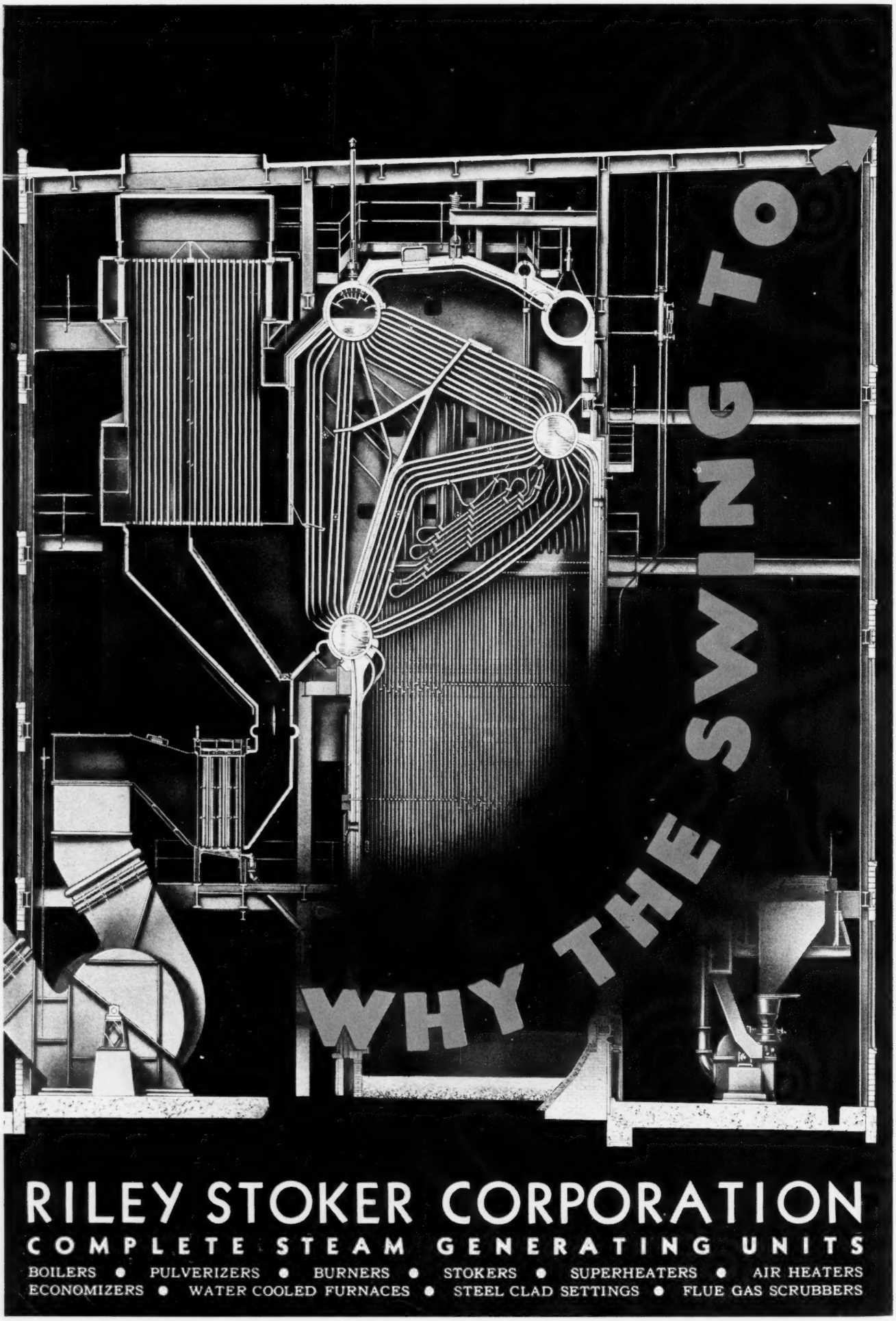
The Water and Light Department is under supervision of J. C. Bang, superintendent for 15 years.



STEAM-DIESEL TEAMWORK

• Litchfield, Minn., adds a 606-kw. diesel-generator set for better heat balance in its municipal light, heat, power and water plant





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COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER COOLED FURNACES • STEEL CLAD SETTINGS • FLUE GAS SCRUBBERS

STEAM GENERATING UNITS

OUTSTANDING PERFORMANCE RESULTING FROM DISTINCTIVE CHARACTERISTICS OF RILEY UNITS IS THE ANSWER . . . . . .

The design of the Riley Boiler is based on the Ring Flow Unidirectional principle of circulation

1 MINIMUM RESISTANCE TO CIRCULATION. The large areas provided through boiler tube banks reduce resistance to circulation to a minimum.

2 MAXIMUM FORCE PRODUCING CIRCULATION. All tubes exposed to high temperatures carry upward flow of water and steam bubbles. This directional effect together with the large head producing flow insures rapid, positive circulation in a fixed direction in all of the tubes, with a very definitely increasing rate of circulation as the steam output increases.

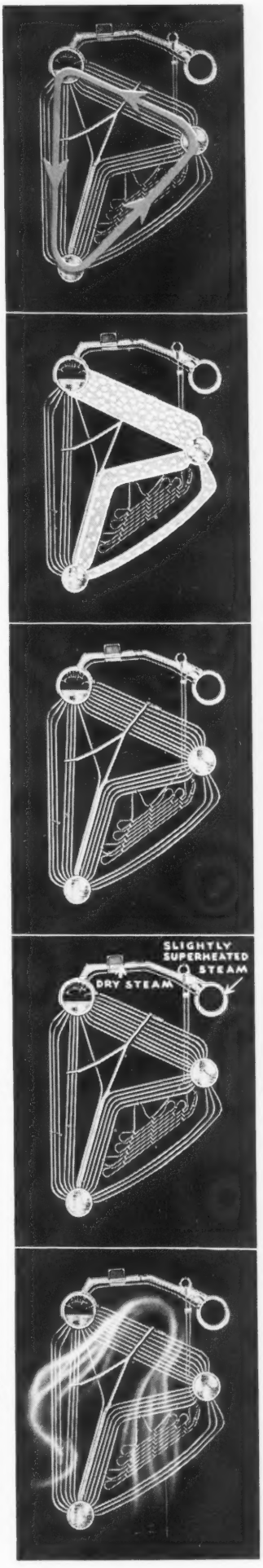
The rapid circulation resulting from the above design characteristics, immediately removes all steam bubbles as formed, insuring proper intimate contact between water and tubes which, together with gas baffling for the most effective heat transfer, results in low flue gas temperatures.

3 UNIFORM STEAM COLLECTION. The steam is uniformly collected at low velocity by the overcomer tubes evenly spaced over the entire length of the drum. It is apparent that uniform distribution of steam to all superheater tubes also results from this design.

4 DRY, SLIGHTLY SUPERHEATED STEAM. Overcomer tubes connecting the third and fourth drums entirely remove the slight residual moisture from the steam and deliver it dry and superheated 10 to 20 degrees F. to the fourth drum.

5 CROSS FLOW OF GASES OVER HEATING SURFACES. Riley Boilers are baffled so as to obtain cross flow of gases over the heating surfaces with most effective heat transfer resulting. Baffling is so arranged and gas passages so proportioned as to result in unusually low draft losses. Careful consideration is also given to provision for easy access for inspection.

In addition to the above, and other distinctive features of design, you are assured, when purchasing Riley Steam Generating Equipment, of the highest quality materials and workmanship both in manufacture and erection. Unusual satisfaction, high efficiency, continuity of operation, and low maintenance result from these plus values. A visit to some of the recent installations of Riley Steam Generating Units will make these plus values perfectly apparent to you. One-eighth-inch scale drawings of recent Riley installations will be gladly sent you upon request.



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ECONOMIZERS-WATER-COOLED FURNACES-STEEL-CLAD SETTINGS-FLUE GAS SCRUBBERS

SEAMLESS STEEL PIPE DATA

Nominal Pipe Size	Diameter Inches: External	Diameter Inches: Internal	Diameter Inches: Thickness, Inches	Circumference Inches: Outside	Circumference Inches: Inside	Transverse Area Square Inches: External	Transverse Area Square Inches: Internal	Transverse Area Square Inches: Metal	Length in Ft. Per Sq. Ft.: External Surface	Length in Ft. Per Sq. Ft.: Internal Surface	Length of Pipe Containing One Cu. Ft.	Contents in Gal. Per Lineal Foot	Weight Per Lineal Foot, Plain Ends Lb.	Weight of Water Per Lineal Foot Lb.	Sq. Ft. of Heating Surface Per Lineal Foot	Moment of Inertia	Section Modulus	Radius of Gyration	Radius of Gyration Squared	Nominal Pipe Size
400 lb. Steam Pressure																				
½	0.840	0.622	0.109	2.639	1.954	0.554	0.3039	0.2501	4.547	6.141	473.906	0.0158	0.850	0.132	0.220	0.01709	0.04069	0.2613	0.06828	½
¾	1.050	0.824	0.113	3.299	2.589	0.866	0.5333	0.3327	3.637	4.635	270.034	0.0276	1.130	0.230	0.275	0.03704	0.07055	0.3337	0.1113	¾
1	1.315	1.049	0.133	4.131	3.296	1.358	0.8639	0.494	2.904	3.641	166.618	0.0449	1.678	0.374	0.344	0.08734	0.1328	0.4205	0.1769	1
1¼	1.660	1.380	0.140	5.215	4.335	2.164	1.495	0.669	2.301	2.768	96.275	0.0774	2.272	0.645	0.435	0.1947	0.2346	0.5397	0.2913	1¼
1½	1.900	1.610	0.145	5.969	5.058	2.835	2.036	0.799	2.010	2.372	70.733	0.106	2.717	0.883	0.497	0.3099	0.3262	0.6226	0.3875	1½
2	2.375	2.041	0.167	7.461	6.411	4.430	3.272	1.158	1.608	1.872	44.000	0.170	3.938	1.418	0.622	0.710	0.598	0.786	0.6135	2
2½	2.875	2.469	0.203	9.032	7.757	6.492	4.788	1.704	1.328	1.547	30.077	0.248	5.793	2.070	0.753	1.530	1.064	0.9474	0.8976	2½
3	3.500	3.068	0.216	10.9951	9.638	9.621	7.393	2.228	1.091	1.245	19.479	0.383	7.575	3.190	0.916	3.017	1.724	1.164	1.354	3
3½	4.000	3.548	0.226	12.5661	11.146	12.566	9.888	2.678	0.954	1.076	14.565	0.513	9.109	4.280	1.048	4.788	2.394	1.337	1.787	3½
4	4.500	4.026	0.237	14.137	12.648	15.9041	12.73	3.174	0.848	0.948	11.312	0.660	10.79	5.500	1.179	7.233	3.214	1.510	2.279	4
5	5.563	5.047	0.258	17.477	15.856	24.306	20.01	4.296	0.686	0.756	7.198	1.04	14.62	8.660	1.458	15.16	5.451	1.878	3.26	5
6	6.625	6.049	0.288	20.813	19.003	34.472	28.74	5.732	0.576	0.632	5.010	1.491	19.49	12.42	1.736	28.84	8.71	2.243	5.034	6
8	8.625	7.938	0.343	27.096	24.938	58.426	49.49	8.936	0.443	0.482	2.910	2.561	30.40	21.38	2.262	76.80	17.8	2.932	8.60	8
10	10.75	9.960	0.395	33.772	31.290	90.763	77.91	12.853	0.355	0.384	1.850	4.04	43.68	33.61	2.817	172.5	32.1	3.665	13.42	10
12	12.75	11.75	0.500	40.055	36.913	127.676	108.4	19.276	0.299	0.334	1.328	5.63	65.42	46.80	3.344	361.5	56.7	4.33	18.76	12
14	14.00	13.00	0.500	43.982	40.841	153.938	132.7	21.238	0.272	0.294	1.085	6.88	72.09	57.30	3.66	483.8	69.0	4.77	22.75	14
16	16.00	14.94	0.5312	50.265	46.936	201.062	175.3	25.762	0.238	0.256	0.821	9.11	83.77	75.80	4.18	773.3	96.65	5.48	30.01	16
18	18.00	16.81	0.5931	56.549	52.810	254.469	222.0	32.469	0.212	0.227	0.649	11.54	104.4	96.20	4.72	1231.0	136.7	6.16	37.95	18
20	20.00	18.75	0.625	62.832	58.905	314.159	276.1	38.059	0.191	0.204	0.522	20.08	129.3	167.50	5.23	1787.0	178.7	6.85	46.95	20
24	24.00	22.50	0.750	75.398	70.686	452.389	397.6	54.789	0.159	0.170	0.362	20.62	186.2	172.00	6.27	3705.0	308.8	8.20	67.65	24
600 lb. Steam Pressure																				
½	0.840	0.546	0.147	2.639	1.715	0.554	0.2341	0.3199	4.547	6.995	615.017	0.01216	1.087	0.1012	0.220	0.02008	0.04780	0.2505	0.0627	½
¾	1.050	0.742	0.154	3.299	2.331	0.866	0.4324	0.4336	3.637	5.147	333.016	0.02245	1.473	0.1855	0.275	0.04479	0.08531	0.3214	0.1033	¾
1	1.315	0.957	0.179	4.131	3.007	1.358	0.7193	0.6387	2.904	3.991	200.193	0.0374	2.171	0.312	0.344	0.1056	0.1606	0.4066	0.1653	1
1¼	1.660	1.278	0.191	5.215	4.015	2.164	1.283	0.881	2.301	2.988	112.256	0.0666	2.996	0.555	0.435	0.2418	0.2913	0.5237	0.2743	1¼
1½	1.900	1.500	0.200	5.969	4.712	2.835	1.767	1.068	2.010	2.546	81.487	0.0992	3.631	0.766	0.497	0.3912	0.4118	0.6082	0.3663	1½
2	2.375	2.000	0.1875	7.461	6.283	4.430	3.142	1.288	1.608	1.911	45.81	0.163	4.380	1.36	0.622	0.7764	0.653	0.777	0.603	2
2½	2.875	2.441	0.217	9.032	7.669	6.492	4.679	1.813	1.328	1.565	30.80	0.243	6.160	2.02	0.753	1.611	1.122	0.943	0.889	2½
3	3.500	3.018	0.241	10.996	9.481	9.621	7.153	2.4681	1.091	1.270	20.15	0.3715	8.388	3.09	0.916	3.294	1.880	1.155	1.336	3
3½	4.000	3.438	0.2812	12.566	10.800	12.566	9.283	3.2834	0.954	1.112	15.51	0.482	11.17	4.02	1.048	5.712	2.856	1.318	1.739	3½
4	4.500	3.938	0.2813	14.137	12.371	15.904	12.18	3.724	0.848	0.973	11.82	0.632	12.67	5.26	1.179	8.332	3.700	1.495	2.236	4
5	5.563	4.859	0.352	17.477	15.265	24.306	18.54	5.766	0.686	0.787	7.77	0.963	19.59	8.02	1.458	19.65	7.075	1.846	3.410	5
6	6.625	5.855	0.385	20.813	18.394	34.472	26.92	7.552	0.576	0.653	5.35	1.40	25.66	11.68	1.736	36.87	11.140	2.21	4.884	6
8	8.625	7.688	0.4688	27.096	24.152	58.426	46.42	12.006	0.443	0.498	3.10	2.41	40.83	20.10	2.262	100.2	23.100	2.89	8.355	8
10	10.75	9.688	0.5313	33.772	30.435	90.763	73.72	17.043	0.355	0.395	1.955	3.81	57.98	31.75	2.817	223.0	41.400	3.62	13.100	10
12	12.75	11.50	0.625	40.055	36.128	127.676	103.9	23.776	0.299	0.333	1.387	5.38	80.94	44.80	3.344	438.7	68.750	4.29	18.450	12
14	14.00	12.69	0.656	43.982	39.867	153.938	126.4	27.538	0.272	0.302	1.140	6.56	93.52	54.60	3.66	614.0	87.750	4.72	22.300	14
16	16.00	14.50	0.750	50.266	45.553	201.062	165.1	35.962	0.238	0.264	0.8725	8.59	122.2	71.50	4.18	1047.0	130.875	5.40	29.150	16
18	18.00	16.38	0.8125	56.549	51.459	254.469	210.7	43.769	0.212	0.234	0.6830	10.95	149.1	91.25	4.72	1623.0	180.333	6.09	37.100	18
20	20.00	18.19	0.9063	62.832	57.145	314.159	259.9	54.259	0.191	0.211	0.5540	13.50	184.8	112.4	5.23	2483.0	248.300	6.76	45.750	20
24	24.00	21.94	1.0313	75.398	68.926	452.384	378.1	74.284	0.159	0.174	0.3810	19.65	253.0	163.8	6.27	4917.0	409.000	8.14	66.200	24

A. S. T. M. specification A106–29.

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By G. W. Purdy

Special Guide-Shoe Gibs

QUIET ELEVATOR CARS

By J. C. Edgecumbe
New York, N. Y.

HIGHER car speeds and higher-rise cars have accentuated the elevator noise problem. Long rails are more difficult to keep in alignment, yet even slight misalignment causes noise at high speeds. The problem of guide-rail lubrication is also increased, for automatic lubricators entirely satisfactory for medium-speed medium-rise cars may prove inadequate for faster and higher-rise service. To top it all off, passengers have become noise conscious, and a car that a few years ago classed as fairly quiet is today rated as noisy and unsatisfactory.

All this means that closer attention must be given to every detail that affects quietness and smooth operation. Among these details are guide-shoe gibs. Early guide shoes were cast iron, unlined and bolted solidly to the car. Later they were babbitted, made adjustable, and held to the rail by spring tension, a standard method of fastening even today. But materials have become much more diversified, varying with conditions through cast iron, oil-impregnated wood, wood with babbitt inserts, horn fiber, horn fiber with lubricating compound inserts, Bakelite or other molded products with canvas base (such as Malikite, etc.), Malikite, fiber or wood faced with steel, bronze, nickel-copper alloy, and other metals.

Fibrous materials, such as wood or Malikite, improve car-riding qualities and better guide-rail lubrication. An oil-impregnated maplewood gib, *D*, has these qualities in high degree but lacks wearing strength and may split under severe operating conditions. Holes filled with babbitt on its inner surfaces, *C*, improve its wearing qualities. These gibs, like most non-metallic types, are made in three parts, two sides being dowelled to a back. Horn-fiber gibs, *A*, are usually similar in design to wood gibs, but do not have babbitt inserts because the wearing qualities of fiber are about equal to those of babbitt.

The Malikite gib, *B*, is similar in construction, but has face inserts of lubricating-compound. Malikite is a tough, resilient molded product with canvas base, therefore is not easily broken, chipped or cracked in service. Its inherent quasi-lubricating qualities produce a highly glazed surface from constant rubbing on the rail, augmented by the grease inserts. For slow- and medium-speed cars operating on good rails, these gibs are practically self lubricating.

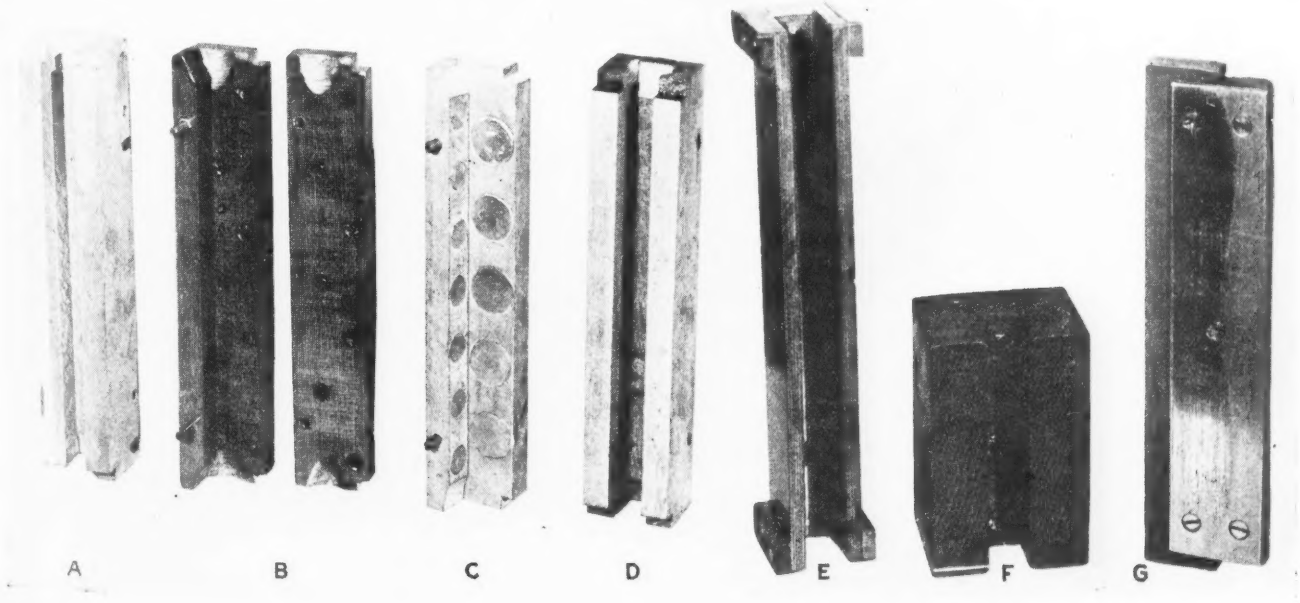
This property is utilized in several large buildings in which guide rails are lubricated only at long intervals. Further, the holes on the rubbing surfaces have a tendency to pick up grease where there is an excess and to redistribute it where there is a deficiency. Recesses are cut into the gib ends into which grease may be packed at intervals to assist in lubrication.

With high-speed cars, however, it is necessary to lubricate guide rails with this type gib just as with other types, except that the non-metallic gib is less likely to "bite" a dry guide rail than is its metallic prototype, thereby simplifying the lubrication problem.

The Malikite gib, *E*, has flanges at each end to hold it in place in the guide shoe, and the gib is riveted

Types of Guide-Shoe Gibs Made of Fibrous Materials

A—horn fiber, B—Malikite with lubricating-compound inserts, C—wood with babbitt inserts, D—oil-impregnated maple, E—one-piece gib built up of Malikite, F—counterweight buffer gib which is one piece Malikite with lubricating-compound insert, G—one part of a 3-part fiber gib lined with metal to increase wearing life.



together just as if it were cast babbitt. *F* is a counterweight buffer guide-shoe gib of the same material. *G* pictures one side of a 3-part metal-lined gib (back and two sides) held to the rail surface by a flat spring extending its full length. Each gib section has a back recess into which the spring fits. Metallic wearing surfaces give it good wearing qualities, while the non-metallic body and springs give it resiliency that tends to keep noise and "rough-riding" from reaching the car, even in high-speed service. Also, with 3-part construction, any worn part can be replaced without replacing the entire gib.

Before any type of gib will operate successfully, not only must rails be in alignment but their surfaces and joints between must be smooth. Rails can be surfaced by putting cast-iron gibs in the guide shoe and lubricating the rails with a mixture of sulphur and oil. The car is run until the rails attain a good surface, then rails are cleaned thoroughly with kerosene, the guide-shoe gibs are replaced, the rails lubricated with the regular lubricant, and normal operation started.

If the car does not hang in good balance between the rails, parts of the guide shoes will wear more rapidly than they should. Several ways of attaching car and hoisting ropes, particularly automatic rope equalizers, provide a method of shifting car balance so that it hangs true.

Life obtained from a set of gibs varies widely with conditions. Under good operating conditions, either metallic or non-metallic gibs of the Malikite type will give 30,000 car-miles or more service. Fiber will in general have shorter life; wood usually isn't as good as fiber. On the other hand, cost of gibs of the various materials varies about in proportion to wearing quality, so the most economical material must be selected to suit the particular job.

SCALING YOUR CHARTS

By A. A. Merrill

Industrial Engrg. Dept.,
General Electric Company

DO YOU have trouble in choosing a scale for your charts? Have you fumed over a chart with a scale most difficult to read? This article was inspired by the latter case, Fig. 1 being the chart of inspiration. For example, using Fig. 1, try to find the value of T/A corresponding to 74 amp.

A simple method of calculation of chart scales is outlined below, to assist in plotting curves on printed coordinate paper. Of course, if your chart grids are especially drafted for each particular graph, this method does not apply.

The procedure is:

1. Count the divisions of the grid along which the scale is to be plotted.
2. Divide the maximum range of the scale desired by 1. Call the result (b).
3. Select the number in the following series which is next larger than (b), and let one division of the grid equal this number. The series: 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, etc.

Note: The only numbers that need be remembered are 1, 2, and 5. Multiply and divide by multiples of 10 to obtain the figure applicable.

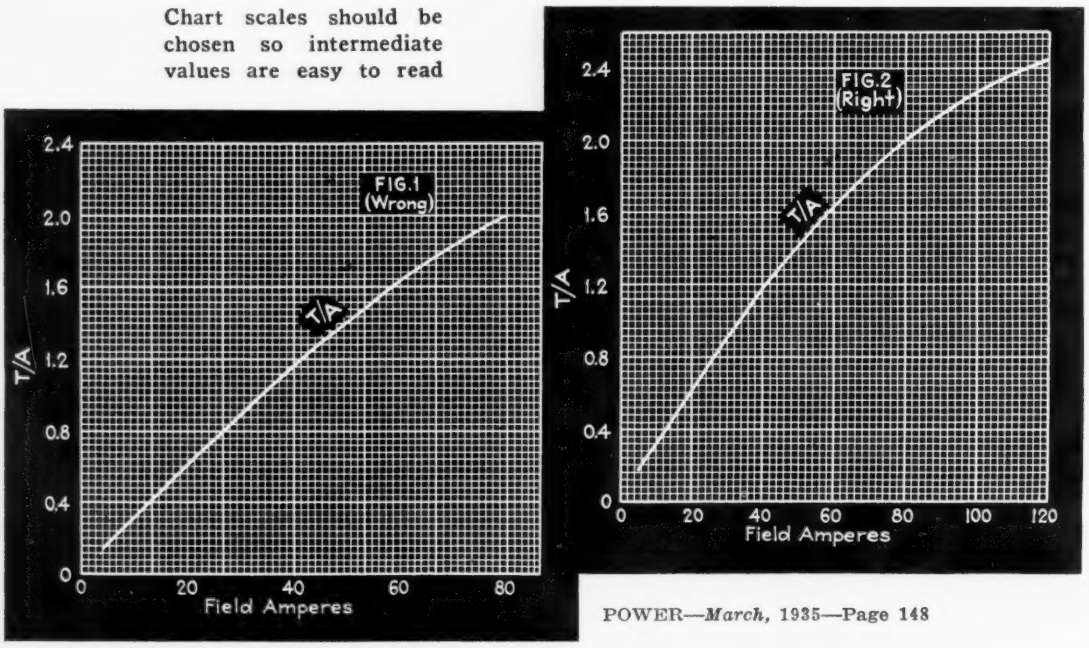
Example: In Fig. 1, consider the horizontal scale, "Field Amperes." The number of grid divisions available is 65. The maximum range desired is 80 amp.

$$(b) = \frac{80}{65} = 1.23$$

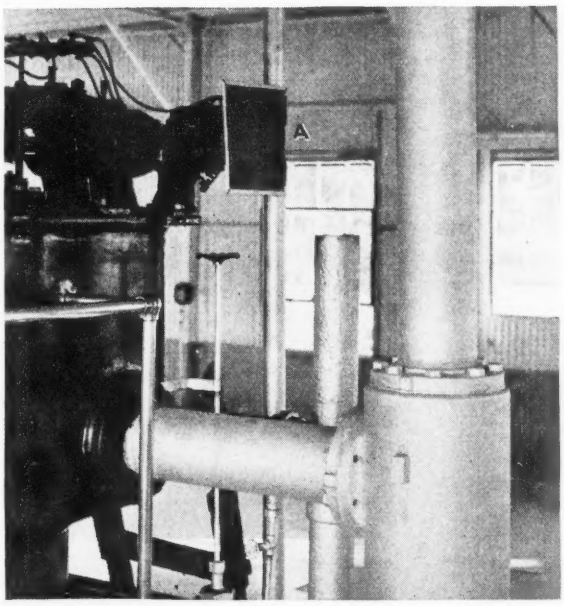
The next higher number in the series is 2, so let each division of the grid equal 2 amp., and lay out the scale accordingly, as shown in Fig. 2 below.

The curves resulting from this method may not fill the chart grid entirely, and may cross the grid lines at a fairly flat angle, but the ease of reading of intermediate points will overbalance the objections. After all, a chart is made to be read.

Chart scales should be chosen so intermediate values are easy to read



PRACTICAL AIDS TO OPERATION



Excessive Temperature Caused Gas-Engine Magneto Trouble

IT WAS found difficult to regulate the speed of several natural-gas engines within the close limits necessary and formerly possible. Mixing, inlet and exhaust valves were reground and checked; spark and magneto breaker gaps carefully adjusted exactly to manufacturers' specifications. A recording manometer, attached first to the gas main and then in turn to the feeder for each of the units, showed uniform charts, the only fluctuations being directly traceable to the surging demand of the engines.

It was not until the magneto repair cards were studied that a possible cause of the trouble was located. On the right-hand magneto on each engine it was found that the bearing behind the breaker mechanism had been replaced on an average twice for each replacement of the other bearing. The latter, which carried the driving gear and impulse couplings, should have worn out first. At the next shutdown interval, suspected magneto units were examined, and their right bearings were found worn so badly that when the magneto was turned, the break for the firing spark varied over an arc of 10 deg. on the flywheel. Replacement of the worn-out bearings returned each magneto to its former regularity, and the erratic operation of the engines was eliminated.

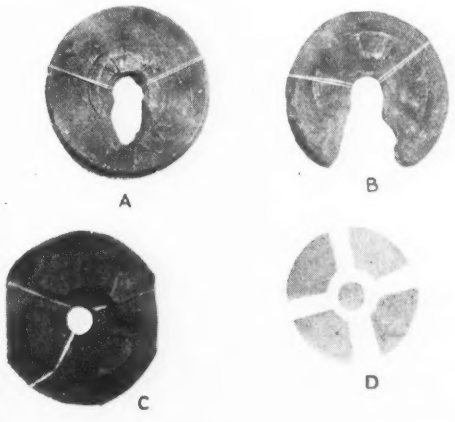
For structural reasons and to provide additional heating during winter, engine mufflers were set within the building. Exhaust pipes rose vertically until just below the roof trusses, then ran horizontally outside. It was found that the magneto giving trouble on each engine was exposed to the high temperatures of the exhaust pipe. Shields made from a sheet of heavy tin, 12x14 in. in size, and faced with asbestos, were supported to protect the magneto as at *A* in the figure. Temperature readings at the magneto were 95 deg. F. with the shield in place and 147 deg. with the shield removed. Ball bearings of the magneto, packed with light grease supposed to run for a year without renewal, were heated by the exhaust pipe to a temperature that prevented their proper lubrication. Since the shields were installed, no trouble has been experienced with magneto bearings, and speed regulation six months after overhaul is as close as when the units went into service.

Longview, Tex. ELTON STERRETT

New Valves Needed, Not a New Pump

BEFORE concluding that an old pump is too small for the job and buying a new one, it is a good idea to check up on the old one's condition, as this case illustrates. A steam-driven 10x6x10-in. plunger pump had been in service for many years supplying pressure water to operate hydraulic elevators. This pump gradually became noisy and seemed to have difficulty in supply the required amount of water. The operating engineer came to the conclusion that the pump was too small and had it replaced by a 12x8x12-in. unit, with twice the capacity. This pump now makes one stroke about every 4 min., therefore is several times too large for the service.

Recently one of my assistants opened the old pump to determine its condition. Photos *A, B* and *C* show three valve disks taken from the pump, and *D* shows the shape of the openings through the valve seat. These three disks are representative of the other 29 in the pump except one which had



disappeared. It is clearly evident why the old pump was noisy and could not supply sufficient water. A new set of valves for the old pump would have saved the price of a new pump and at the same time given four or five times as much capacity as needed.

New York, N. Y. P. SCAGNE

Oil on Blading Threw Turbine Out of Balance

A RATHER unusual cause of trouble was found recently in a 7,500-kw., 3,600-r.p.m. condensing turbine driving a generator through a reduction gear. Operation was satisfactory for several years, then a slight vibration was noted, which gradually increased until it was considered necessary to determine the cause.

A heavy oil deposit was found on the blading of the last five stages. This was heavy enough to unbalance the rotor and retard normal steam flow through the blading. An ordinary paint spray gun was connected to a 100-lb. compressed air system, and carbon-tetrachloride was sprayed on the deposit to clean the blading. This did a perfect job. (Anyone using this method should protect his eyes with a pair of tight-fitting goggles and should wear a mask, unless ventilation is good.)

Piping and general hook-up in this installation were checked to determine the source of the oil. Exhaust from a duplex steam-driven oil pump was piped to the drainpipe from the bottom of the turbine casing. This oil pump served as an emergency unit to supply oil under pressure when starting the turbine. At such times it was customary to have the drain valve from the turbine casing open until all parts were at operating temperature. Until steam pressure in the turbine casing was high enough to cause flow through the drain piping, exhaust steam from the oil pump passed through the turbine into the condenser. When the turbine was in operation, high steam temperature in the first stages scrubbed the oil off the blading, but in the low-pressure stages where the temperature was comparatively low the oil remained. A check valve installed in the drain line eliminated any future trouble.

Brookline, Mass. HARRY M. SPRING, JR.

Separating Oil From Exhaust Steam

OIL separators will take oil out of exhaust steam, provided the drain is kept clear to the trap and the trap made to leak a little steam through to the discharge all the time. Trouble from oil in dye house water was cured by this means. The plant had two 10,000-gal. tanks, in which water was heated by exhaust steam pipes which discharged into the bottom of the tank. By letting the oil-separator drain traps leak steam through the discharge all the time, trouble from oil in the water was eliminated.

Chester, Pa. FRANK MCLEAN

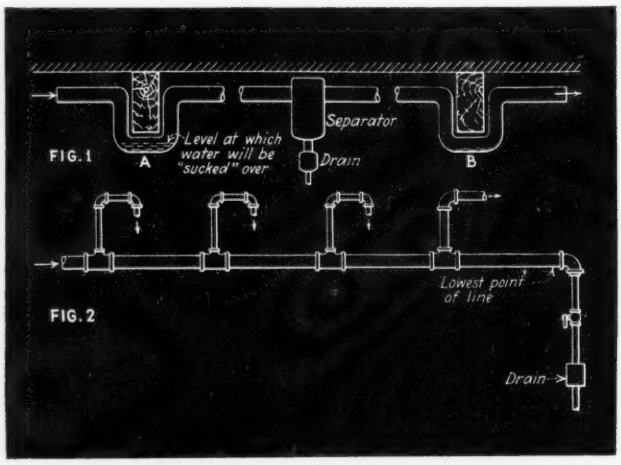
Proper Draining Keeps Air Lines Free of Water

IT IS often surprising how much water will be blown out of compressed-air line when a valve is opened. Water is carried along with the air until it reaches a zone of sufficiently low velocity, where much of it settles out and collects in low spots, such as a receiver. When demand is light, velocity and temperature in the receiver may be low enough to permit precipitation of a large part of the moisture in the air. But when demand is great the air may cool but little in the receiver and most of the condensation will then occur in the lines, unless an aftercooler is used on the compressor. High air velocity in the receiver may whip up the water that has collected there and carry some of it along into the lines. Hence it is advisable to drain the receiver automatically.

A separator may be placed in the compressed-air line to remove water and oil that usually accompanies the air. The separator will not be of much value, however, if it is so located that the air can cool after passing through it, because additional precipitation occurs as the air cools. The ideal location for a separator is at the point of use. This insures that no further precipitation can occur before the air is used. If this cannot be done, then care should be taken to place the separator in the line where the air has cooled to room temperature. The separator should be kept well drained at all times.

Avoid pockets in air lines and slope them slightly in the direction of flow if possible. If pockets cannot be avoided, they should be drained automatically. A pocket can cause trouble if it is before or after the separator. If a pocket is back of the separator, as at *A*, Fig. 1, water may collect in it during periods of low velocity until the effectvie area of the pipe is reduced until the air velocity will carry a slug of water into the separator. If this slug exceeds the amount that the separator can eliminate momentarily, some of it will pass into the line again and perhaps cause damage or annoyance at the point of use.

It might appear that a low point in the line after the



separator, as at *B*, Fig. 1, would not be objectionable. Separators are not 100 per cent efficient, and if occasional droplets of water come through with the air, these might collect at *B*, until a sudden increase in flow might pick up the water lodged there and carry it to the work. A separator located in a horizontal or sloping run of pipe would prevent such difficulties. Points such as *A* and *B*, if unavoidable, should be connected to a drain.

An excellent way to take off branch lines from an air main is shown in Fig. 2. If air is taken from the top of the main and the low end of the line drained automatically, the air should always be in first-class condition.

New York, N. Y. CHARLES C. PHELPS

Put Obstruction Lights on Elevated Equipment

INCREASING use of aircraft for transportation has created a hazard in elevated equipment such as stacks, storage tanks, and transmission-line towers. This is particularly true where these structures are on extensively traveled airways or are near landing fields and airports. To avoid damage to elevated equipment, underlying structures, and possible disaster to planes with loss of life, obstruction lights should be provided.

There are several ways to light elevated structures effectively. Vapor-proof fixtures with red globes are widely used. If these fixtures are mounted on top of buildings and on the tops and supporting framework of storage tanks and trans-

mission line towers, adequate protection is usually obtained.

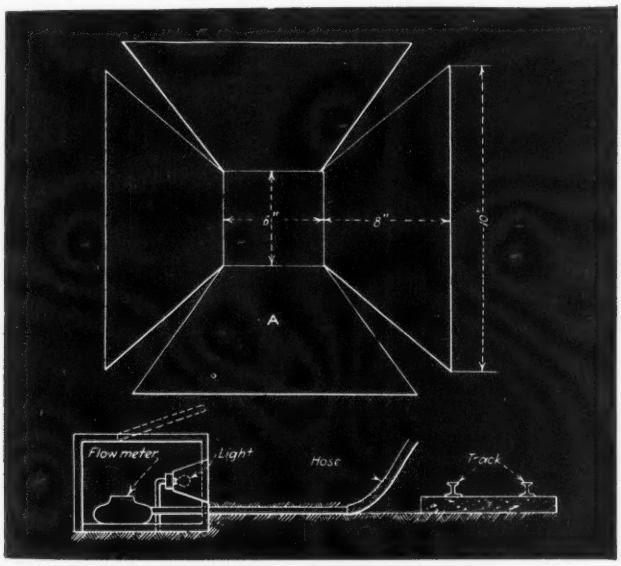
Obstruction lighting of stacks presents difficulties. Vapor-proof fixtures mounted near the stack top are sometimes used, but are generally unreliable due to heat, corrosive gases, sooting up of globes, and difficulty of maintenance. Floodlighting of stacks with projectors mounted at their bases is common practice. These floodlights are sometimes provided with red lenses. In addition to protecting the stack and aircraft, floodlights can aid publicity by illuminating advertising material painted on the structure.

Waynesboro, Va. S. H. COLEMAN

Installs Light in Fuel-Oil Meter Box

FUEL-OIL storage tanks for a battery of boilers were alongside a railway siding close to the boiler room. Connections to valves on the tank cars were made by a hose to a recording flowmeter, housed in a wooden box. Emptying these tank cars was done quite often at night, requiring the boiler-room attendant who did the work to keep a lantern handy. To avoid this a permanent light and switch were installed in the meter housing.

A piece of $\frac{1}{8}$-in. sheet copper was cut as at *A* in the figure, and tinned to improve its light-reflecting qualities. The four sides were then bent until the edges touched, then were sweated together. A 4-in. outlet box and cover, with a sign receptable, were secured to the 6-in. square back of the reflector. An opening was cut in the side of the meter housing facing the track and the reflector inserted and secured by



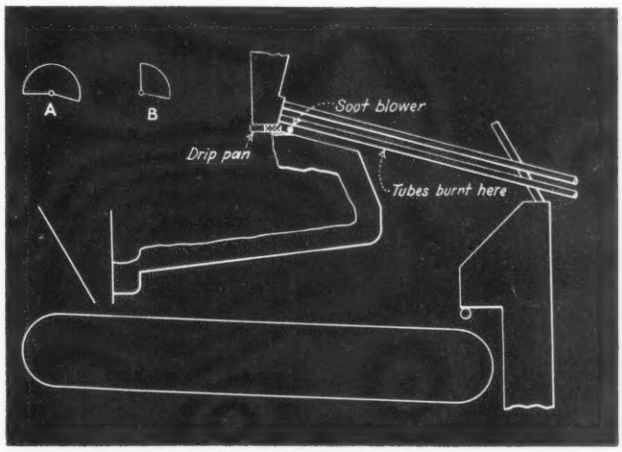
wood screws, power for the light being taken from the tank storage room. This light also provided an outlet for an extension light when needed.

Montreal, Que. J. E. WRIGHT

Improper Soot-Blower Installation Caused Boiler-Tube Failure

REPEATED burning out of bottom-row tubes of a group of water-tube boilers was for a long time a matter of much speculation. Scale or oil was first blamed, but neither was found present in sufficient quantities to be dangerous. Failures always occurred at the same distance from the front header at the position indicated on the diagram, and looked as if a blow-torch had been directed on the tubes. We decided that delayed combustion was causing the trouble.

With a chain-grate stoker burning Illinois coal, distillation of volatiles takes place very rapidly in the furnace front end. There is a deficiency of air through the fuel bed at this point for complete combustion. With poor furnace design and



without devices to supply over-fire air and create turbulence, the gases stratify and pass out of the furnace unburned.

If before these gases become cooled below their ignition temperature, a supply of air reaches them, combustion takes place and an extremely hot flame having a blow-torch action will result.

When looking for a possible air supply to cause the trouble it was found that the soot blower located as indicated had been installed with an arc of travel as shown at *A*. The steam jets impinged directly on the front header and made it impossible to keep an air seal between the header bottom and curtain wall. With air flowing through this opening and contacting unburned gases from the furnace, combustion occurred and was localized where the tubes failed.

Soot-blower arc of travel was changed as at *B* and an air seal was provided under the front header by laying a row of brick, calking with asbestos rope and finishing with an asbestos fire-clay plaster. Provisions were also made for admission of air over the fire. Since correcting the conditions no further experience of tube failures has occurred.

Springfield, Ill. JULIUS BRODSKY

Thermal Relays Tripped by High Ambient Temperature

WE WERE having trouble with a motor-driven oil burner used on a kiln. The thermal relay would trip for no apparent reason. After a short interval the relay could be reset and no trouble would appear until some time later. We thought that heat from the kiln was causing the trouble, because the starting switch was mounted on the kiln wall a short distance from the burner. We loosened switch box and allowed it to hang away from the wall, and no more trouble was experienced for several days.

There was no other place to mount the switch box conveniently, so longer bolts were obtained to fit into the expansion anchors and $\frac{3}{8}$-in. nut placed on the bolts between the box and wall. This provided an air space in back of the switch, and the circulation kept the temperature in the box sufficiently low so that no more trouble occurred.

Waterloo, Wis. H. B. HUMPHREY

CURRENT COMMENT

Condensate Won't Drain Against A Hurricane

IN THE very interesting article published in *February* POWER on the design and layout of piping, you say "Better drainage is obtained if the lines are sloped in the direction of the steam flow."

This is undoubtedly true, but I wonder how many people realize just how true it is. It would I think, be more correct to say that except in the case of very low-velocity steam, as that found in some heating systems, it is quite impossible to get effective drainage against the steam flow.

Consider a steam velocity of 6,000 f.p.m. This is a velocity of nearly 70 miles an hour, and of course a velocity of 12,000 f.p.m. would be double that, or nearly 140 miles an hour. Now a wind velocity of 60 to 70 miles an hour is classed as a "great storm" and 80 to 100 miles an hour as a "hurricane or cyclone."

What chance have we to get water to flow down a grade of even as much as 1 ft. in 20 ft. against a hurricane?

Unfortunately, many designers of piping systems appear unable to visualize the conditions which must exist when steam is flowing. Most of us I think, have a picture of a thin sheet of water flowing quietly along the bottom of a pipe, but once we realize that the water may be exposed to a force equal to that of a West Indian hurricane we shall be in a much better position to solve our drainage problems intelligently. Not only will we not expect to drain condensation against steam flow, but we shall appreciate the fact that satisfactory drainage is not a simple matter at all, but one which calls for a great deal of thought.

Bloomfield, N. J. JAMES O. G. GIBBONS
Consulting Engineer

Why Not Use Bleeder Turbine?

WHY do none of your correspondents mention the possibility of using an extraction turbine to supply the process steam and electrical loads given in the October question by W.W.D.? If the power load is always in excess of the process steam requirements, surely such a machine should be given consideration. A good impulse-type extraction turbine, if supplied with steam at 125 lb. pressure and 100 deg. superheat and exhausting into a vacuum of 28.0 in. Hg. should have a straight condensing steam rate of about 20 lb. per kw.hr. Steam could be bled from this machine at a point giving approximately 5 lb. pressure and would be dry saturated or slightly superheated at this pressure, if the initial superheat is 100 deg. F. Steam consumption of the turbine would be increased by only about 0.55 lb. for every pound of steam extracted for process. Straight condensing steam rate at 50% load would be about 10 to 12% higher than that at full load for the same operating conditions.

In England, units of about this size are manufactured by several firms in which the turbine, generator, gear-box, condenser, air ejectors, and extraction and circulating pumps are all mounted on one bed-plate, in which the condenser is incorporated, thus forming a compact unit as regards floor space and requiring a minimum of excavation work.

If a superheater is not provided the steam consumption of the turbine would be about 6½% higher, but the extracted steam would then contain about 4% moisture, and the exhaust about 7½%. If the process requirements necessitate dry steam, provision of a superheater would obviate the need for a steam separator, in addition to improving the steam rate of the turbine.

London, England C. B. ROBINSON

Safe Ending Extends Life of Boiler Tubes

I HAVE been interested in the discussion on installing boiler tubes in two sections as it brings to mind a practice used in servicing locomotives. In fire-tube locomotive boilers and some other types, it is not uncommon to find tube-end thickness seriously reduced by erosion and flame scrubbing. This reduction occurs at the ends where the product of combustion enter and cover an area extending several inches into the tube. This defect is not usually confined to a few tubes but may include a large proportion of them, thereby greatly weakening their holding strength for the tube sheets.

If these tubes are in a boiler supplied with feedwater free from corrosive action, the water side of the tubes may be in excellent condition when their ends become badly eroded in a period of four or five years. To save part of the expense of retubing, a method known as safe-ending is used. By this method the defective end of the tube is renewed and a greater part of the tube, which is sound, is saved and used again.

The tubes are removed and the eroded ends sawed off. Short lengths of the same size tubing (about 6 in. longer than the defective section removed) are procured. These and the ends of the original tubes are sandblasted to assure clean metal. A welding machine is used to connect the end to the tubes. Low-voltage welding current is applied as the machine butts the ends of the original tube and short section together. The machine is held in this position until all arcing stops, a signal to the operator that all voids in the weld have been filled. At this point he increases the compressive pressure against the butt weld and the machine upsets the weld. While the weld is still at high temperature, the tube is passed over a mandrel and, triple steel rollers, roll the weld to the same external diameter as the tube. This is done so that the tube may pass through the tube-sheet holes.

This method is employed both with small flues and sizes up to 5-in. superheater tubes. When welding and rolling operations are completed the tube is tested with compressed air at about 125 per cent of its working pressure, soapy water being painted over the weld to check leakage.

Several of these tubes have been tensile tested to destruction and all failed in metal well outside the weld. Previous to development of the electric arc-welding machine, boiler tubes for railroad practice were safe ended by forge-welding. The short piece to be added was belled out at the end while hot. The end of the boiler tube was swaged down while hot to fit inside the belled end of the short piece. These ends overlapped about ¼ to ⅜ in. This section was then heated to a forging heat, placed over a special mandrel and the joint forge-welded.

Boston, Mass. H. A. WIGGINS

Cause of False Water Level in Water Column

A NEW cross-drum water-tube boiler was installed in a midwestern mill last spring. After two months of service two top rows of tubes developed leakage at the expanded ends in the front headers. These were re-rolled, but in two weeks leakage again appeared at the same point. After the tube ends were re-expanded the second time, a close investigation was ordered to determine the source of trouble.

From all indications the trouble was caused by low water. Boiler operators were questioned and all were positive that the water in the gage glass had never been allowed to go out of sight when the boiler was in operation. The glass was removed. Shutoff valves were found to be in good working order, and connections were not obstructed.

It was finally discovered that the boiler connections on the water column were 3 in. further apart than the connections on the head of the boiler drum. As the water column was nearly 25 ft. forward of the drum, offsetting the lower connecting pipe slightly made it easy for the steamfitters to line up the pipe and make connections tight. They had installed the steam connection practically horizontal, but had offset and bent the water connection so that it pitched toward the water column.

With the piping connected in this manner the water column try-cocks and the gage glass would show nearly 1 in. of water even if the boiler drum was empty.

The proper size water column was immediately installed and the water connecting pipe was pitched towards the drum. No further trouble has been had.

Cleveland, Ohio M. E. WAGNER

Eliminating Oil from Engine Exhaust

IN CONNECTION with the discussion in the September, 1934, number of *Power,* we wish to advise that we have furnished a great many of our engines for operation without cylinder lubrication in both marine and stationary service and that this is really the best method of eliminating oil in the exhaust, provided the steam does not contain too much superheat. We have also had experience with similar operation in the case of superheated steam but we would not ordinarily recommend this for high superheat in the average industrial plant.

There is also the possibility of operating the engine, if the steam is not superheated, with a colloidal solution of graphite and water.

Troy, Pa. E. J. VONACHEN
Troy Engine & Machine Co.

Operating Brains

IN A recent number of *Power* you have stated that in the average power plant there is a waste of 50 per cent. Some years ago I read a U. S. Bureau of Mines bulletin in which they claimed that the preventable fuel loss in the average boiler room is 25 per cent. If your figure is right, the loss in the rest of the power plant is also 25 per cent, giving a total of 50 per cent preventable loss. This means that the average power plant can cut its power cost by half. [The 50 per cent estimate includes also the waste in transmission and application in the factory and the waste due to purchase when the plant should generate and vice versa—Editor.]

To keep a power plant going is one thing; to operate it at its best efficiency is quite another. The usual grade of chief engineer is well qualified to keep a power plant going, but not so well qualified to operate it with minimum fuel requirements.

Economical operation requires a certain knowledge of chemistry and physics and an understanding of combustion, efficiency and accounting principles. Also, a knowledge of what is available in the equipment field and the merit of the different types of equipment offered. In short, power plant efficiency is the province of the technically trained man.

For this reason, the public utility power plant has not only the chief engineers, but also the efficiency engineers to whom economical operation of the plant is entrusted. This is also the practice of industrial concerns with large power plants.

Fuel-saving possibilities of smaller power plants will not warrant the cost of an efficiency department, but satisfactory results can be obtained through the part-time services of a consulting engineer specializing in power-plant efficiency. Such a man is able not only to advise the best methods of operation, but also to judge when older equipment can be replaced at an advantage. Recommendations of this sort coming from such a man are much more likely to be persuasive than when they come from the chief engineer.

Chicago, Ill. N. T. PEF

An Operating Engineer Remembers . . .

. . . The facial expression of a process-equipment operator, whose alibi for production difficulties was fluctuating steam pressure, when confronted with almost perfect pressure charts from a newly installed recording pressure gage.

. . . The wreck of an underfeed-stoker plunger crankshaft bearing when the fireman, having trouble with pins shearing on one plunger, decided to cure the trouble by replacing the soft-iron shearing pin with one of case-hardened steel.

. . . The explosion of a gate valve, the stem and bonnet narrowly missing the water-tender's face. A maintenance man, unable to locate a high-pressure valve, installed a 125-lb. brass gate valve on the 200-lb. boiler-water connection to the feedwater regulator. The water tender, while blowing down the regulator expansion tube, closed this valve. He had just moved away when the threaded connection between bonnet and valve body suddenly failed.

. . . A Minnesota night, the temperature 32 deg. below zero, when the water column blowdown lines on a boiler operating at light load froze and burst.

. . . The plugged vent of the angle-type oil-sight gage that caused an indication of a low oil level when the auxiliary turbine oil reservoir was full. The gage might have shown full with the reservoir empty.

. . . The story told by a service man of trouble encountered trying to get a turbo-generator set to handle its rated load, eventually to discover a serious error in the kilowatt-meter calibration to be responsible for the difficulty.

. . . The feeling experienced standing on the iron cover plate of a pipe trench, and having the plate suddenly lift up and then settle back into place when gasoline vapor, ignited by a welder's torch, exploded. The gasoline had been thoughtlessly poured into the trench after being used for cleaning purposes.

. . . The acrobatics of an operator trying to reach an extraction-line non-return valve balancing arm, when this valve failed to close completely on a back flow of steam, causing the turbine to speed up almost to the tripping point.

Waynesboro, Va. S. H. COLEMAN

READERS' PROBLEMS

QUESTIONS for Our Readers

BOILER VENT OPEN OR CLOSED WHEN FILLING?

Question 1

A SHORT *time ago we hired a new fireman, and to test his experience I one day instructed him to fire up a boiler that had been down for repair, but watched him closely. He examined the boiler to see that all manhole covers were in place and all valves closed except those to the water column and instruments, and then started filling the boiler. Presently I noticed pressure showing on the gage and realized that he had not opened the vent valve, thus trapping air in the boiler. I was interested to see what he would do, so said nothing. He continued filling the boiler until the pressure gage showed about 60 lb., and then inspected all the manhole covers to see if there were any leaks, blew out the water columns and then opened the vent to let out the remaining air. It had always been our practice to open the vent before filling the boiler, and yet this fellow's method had many good points. I am wondering whether Power readers know of any bad effect from filling a boiler with the vent closed and why so many operators keep the vent open?* —P. D. O.

BUILDING UP OIL CIRCUIT-BREAKER CONTACTS

Question 2

WE HAVE *recently started to build up our oil circuit-breaker contact wedges and fingers by oxyacetylene welding, employing copper wire for welding rods. We wish to know how well these welded contact surfaces can be expected to wear in comparison with new parts. It is understood that the composition of the metal deposited by welding is such that wear due to arcing will be so rapid as to make building up by this method unprofitable. How can these contact surfaces best be built up, and how can a metallic coating be applied that will prevent corrosion of these parts while in stock?* ——R. B. G.

Suitable answers to these questions from readers will be paid for if space is available for their publication.

DETERIORATION OF RUBBER COVERED WIRE

ANSWERS to January Questions

THE QUESTION

IT IS *understood that after a number of years rubber insulation will deteriorate dangerously. Some of our circuits that are in iron conduit in dry locations have been in service for 25 years, and although no failures have yet occurred the question of replacing these old circuits while prices are low is before us. Ours is an industrial plant and the motors have operated 8 hr. daily. Room temperatures are normal. The areas of the conductors conform to present day N.E.C. requirements. We would like to know the life expectancy for both rubber and varnished-cambric insulation, also what tests should be made to determine whether or not these old circuits should be replaced. We find that many old splices have been insulated with varnished cambric instead of rubber tape. Is this permitted by the N.E.C. and if not, are the varnished cambric insulated joints likely to give trouble?*

—R. B. G.

Recommend Initiating a Replacement Schedule

RUBBER insulaiton on electrical cables ages, but it will not deteriorate dangerously unless operated under severe service conditions. The chief causes of early failure of rubber-insulated cable are high temperatures and internal or external ionization. High temperatures may be due to climatic conditions (ambient-air), number of loaded circuits in same conduit, character of the surrounding medium (earth, cinder, etc.), proximity of other heat sources (such as other circuits, steam pipes), and other causes. Varnished-cambric insulation on the other hand, is more resistant to the effects of high temperatures and internal or external ionization.

Rubber-insulated cables have been manufactured for fifty years, but in the last ten important improvements have been made. Possibly the greatest achievement has been the use of antioxidants which retard deterioration of rubber. Inasmuch as your installations are 25 years old, and labor and cable costs are low, I would suggest you initiate a replacement schedule. It is cheapest to replace cable during light-load operation before a failure occurs which may involve its own and adjacent circuits and equipment.

Perhaps you would rather initiate a yearly maintenance schedule for these circuits, at which time they should be tested for insulation resistance. Each circuit should be tested between conductors and between conductors and ground with a 1,000-volt megger. All installations showing one or more megohms may be considered satisfactory, if the circuit is not too long and interconnected. Large installations should be split into small sections and each section tested separately.

Low insulation resistance values usually indicate poor insulation between conductors, defective joints or devices, moisture in the conduit, low-resistance grounds and other conditions. Circuits testing less than one megohm should be investigated and the cause of the low resistance determined.

I have always advocated the use of 75% (for dielectric test of old equipment) of the A.I.E.E. standard value of twice rated voltage plus 1,000 volts. Thus, a circuit rated at 440 volts should be tested at 1,410 volts, 60 cycles, for 1 min. between conductors and conductors and ground. If the cable withstands this test successfully then it may be put back into service. Insulation-resistance measurements should be made periodically, and if there is a continual decrease in value, another dielectric test should be conducted.

Varnished-cambric joint insulation should not give trouble in your case, as the circuit locations are dry. Varnished-cambric insulation is reasonably moisture-proof, but unlike rubber cannot be operated safely in continuously moist surroundings.

West New York, N. J. KERMIT B. HOFFMAN
Licensed Professional Engineer

Bases Recommendations on National Electrical Code

RUBBER and varnished-cambric insulations have quite different applications in wiring installations except with respect to surrounding temperature in which both have, according to the N.E. Code, the same permissible temperature. In contrast with rubber insulation, which is adapted to installations where moisture, steam, acid fumes and oil are likely to be encountered, varnished-cambric insulated wire is employed in permanently dry locations not subject to corrosive fumes. Where due consideration is not given to these factors, early insulation failures may follow. Sometimes, where two types of insulated wire seem equally adapted to a particular installation, final selection may be based upon initial cost.

The general insulation condition of the circuits may be determined by a few simple tests. First, motors should be disconnected from their circuits and the insulation resistance between wires and between each wire and conduit measured. If the insulation compares favorably with standards set forth in Article 5, Section 513 of the N.E. Code, insulation strength is still adequate. Second, a visual check of the insulation should be made at pull boxes for indications of physical deterioration such as brittleness. If the insulation is found to be in good condition in these respects, no failures are likely to occur if normal operation is maintained.

In the insulation of splices, rubber tape instead of varnished-cambric should have been used with rubber insulation. The Code specifies that splices shall be covered with an insulation equal to that on the wires. Since the areas of the conductors mentioned in the problem conform to Code requirements and room temperatures are normal and dry, no trouble is likely to develop with varnished-cambric insulated joints unless moisture is encountered.

St. Marys, Ohio J. L. YOUNG

Suggests Making Insulation Tests

No SET rule can be given for life of wires in conduit, as conditions vary too much. Heat, oil, and moisture are deteriorating influences which usually cause failure. When properly protected from these and other less common deteriorating elements, cables should last indefinitely. Testing is the best way to determine insulation condition. There are two common methods. One is for dielectric strength by applying a predetermined overvoltage for a specified time. The most widely used method is an insulation-resistance test. This may be done with comparative safety to the insulation, the test usually being made with a megohmmeter. The 500-volt type is most commonly used on low voltages. The test is taken with the wires at or near their maximum operating temperature, as heat greatly decreases insulation resistance.

I would suggest that R. B. G. make insulation-resistance tests of the cables and compare them with that of new wire of the same class. If the old wire tests equal to, or above N.E. Code standards I would consider it satisfactory; if below I would renew it.

Waynesboro, Va. J. M. MYERS

WHERE TO PUT BRINE PUMP

ANSWERS to January Question 2

THE QUESTION

IT IS *generally customary to install the brine circulating pump ahead of the brine cooler. In a brine system we contemplate installing the brine receiver or surge tank is located about 30 ft. above our shell and tube brine cooler. Plant conditions make it more convenient to install the circulating pump with its suction connected to the cooler instead of the warm brine return. Are any troubles likely to develop because of this location and if so what will they be?*

Pump Placed After Cooler Has Lower Efficiency

BRINE pumps are generally installed ahead of the brine cooler because this location reduces the severity of service to a minimum (from the standpoint of mechanical and hydraulic conditions) as well as facilitating maximum operating economy. Centrifugal pumps are generally used for brine circulating systems, and it is assumed that the pump in question is of this type.

Mechanical difficulties encountered with centrifugal pumps handling liquids at temperatures below atmospheric or room temperature are usually confined to the pump bearings. The low temperature at which the bearings operate induces atmospheric condensation in the bearing; thus the lubricant becomes contaminated with water. Such contamination increases with the decrease in operating temperature of the bearings and materially reduces bearing life.

Hydraulic conditions are more favorable to the pump when installed before the brine cooler, because the maximum static head on the pump suction is available. Such a condition results in steady pump operation, which is desirable. With the pump located after the cooler, the available head on suction is reduced by the friction loss in the cooler tubes. Should this loss exceed the available head on the cooler from the surge tank, the pump must necessarily operate with a suction lift, and should the cooler tubes become fouled sufficiently, pump capacity will rapidly drop. Such a condition may require more frequent cleaning of the cooler than would ordinarily be necessary with the pump placed before it.

To realize maximum operating economy, the brine circulating pump must be before the cooler. With any refrigerating brine solutions, the efficiency of a centrifugal pump decreases with a decrease in pumping temperature. This decrease in pump efficiency represents an increase in required horsepower input to the pump, which is merely overcoming additional friction resulting from cold brine. This additional horsepower is an added operating expense and is dissipated in the form of heat to the brine solution, the cooling of which is one of the operating expenses. Thus, the improper location of the brine circulating pump can increase operating costs by requiring more power to drive, as well as more power to cool, the brine to compensate for its heating in the pump.

It is difficult to estimate the waste in power resulting from the improper location of the pump, as it depends largely on the quantity of brine circulated and its pressure drop in the system, as well as its temperature and viscosity.

While it is possible to eliminate mechanical troubles by proper design, the maximum operating economy is insured only by locating the pump before the cooler.

Harrison, N. J. *J. F. S.*

Pump Location Makes Little Difference

IF THE brine pump is located at about the same level as the brine cooler, there should be no difficulty in getting satisfactory operation. On the basis of a brine density of 10 lb. per gal., a column of brine about 28 ft. high is equivalent to one atmosphere. For successful operation, the suction lift of a pump should not exceed one-half an atmosphere, which in this case is 14 ft. Still lower suction heads are better. The pump will not work if placed on a level with the brine receiver or surge tank if the system is open, but it makes little difference whether it is placed ahead or after the brine cooler if it is on the same level.

Corvallis, Ore. PROF. W. H. MARTIN
Oregon State College

Lubrication May Cause Trouble With Pump After Cooler

ALTHOUGH the inquiry is not very specific as to the conditions under which it is to operate, we may attempt to answer the problem from a general point of view. Since continuous and uninterrupted operation of the unit is of paramount importance, we must consider the possible troubles and breakdowns that may occur because of the proposed arrangement, as well as its effect upon the efficiency of the complete unit.

Because the centrifugal pump has undeniably taken the place of other pumping equipment for this particular service, we shall assume that we are dealing with a centrifugal brine-circulating pump. Plant engineers are, no doubt, familiar with the difficulties presented by pumping brine in comparison to cold water. Properties of the liquid to be handled, as measured by specific gravity and viscosity, must be allowed for in the selection of the pumping equipment and the driving power. In the case of warm brine, which is customarily pumped, the drop in efficiency due to increased viscosity is fairly low. However, a severe drop in the pump efficiency may be expected when pumping out of the cooler, because of the lower temperature and the resulting higher viscosities.

Further consideration must be given to the bearings and their lubrication. In either installation, the temperature of the brine is below that of freezing water. The bearings of a brine pump must be therefore provided with an adequate seal to prevent the moisture present in the surrounding air from condensing inside of the bearings. A lubricating oil must be chosen which will give a satisfactory service at the low temperatures encountered. Both these problems are magnified, however, when the brine pump takes its suction from the cooler. Although the same seal as customarily used will render satisfactory service, it may prove definitely advantageous, in relation to the lubrication problem, to maintain the bearings at a temperature somewhat higher than that of the brine. There are two possible means of satisfying this requirement. Ordinary water-cooled bearings could be installed on the pump, whereby hot water may be circulated through the cored passages. It would be necessary, however, when using such an arrangement to maintain a continuous flow, regardless of whether the pump is operating or not, or to provide a suitable drain in the bearing housing to prevent stagnation and freezing of the water. Another arrangement would make use of electric heating coils within the bearing body, the current through them being interrupted when the pump is not in operation.

A third problem which arises through the proposed pump arrangement has to deal with the pressures available at the pump suction. In the contemplated layout, the pump would have, at its suction, a pressure equivalent to the 30 ft. of submergence, less whatever friction loss there may be experienced through the cooler. Now if the cooler coils were not properly designed for the required capacity, this friction loss may be quite high, to the point where instead of a positive head on the pump suction, there will result an actual suction lift. However, unless all common sense considerations were absolutely disregarded in the construction of the cooler unit, there is very little chance of the friction loss even coming to equal the available submergence of 30 ft.

These points are the only ones which must be considered, and, providing their effects are carefully compensated for, there will be no difficulty in operating the circulating pump with its suction connected to the cooler instead of the warm brine return.

As a matter of fact, there even exists a slight mechanical advantage in such a layout, in that the cooler coils will not be subjected to the full pressure from the pump discharge.

New York, N. Y. I. J. KARASSIK

MORE POWER TO

ELECTRON TUBES

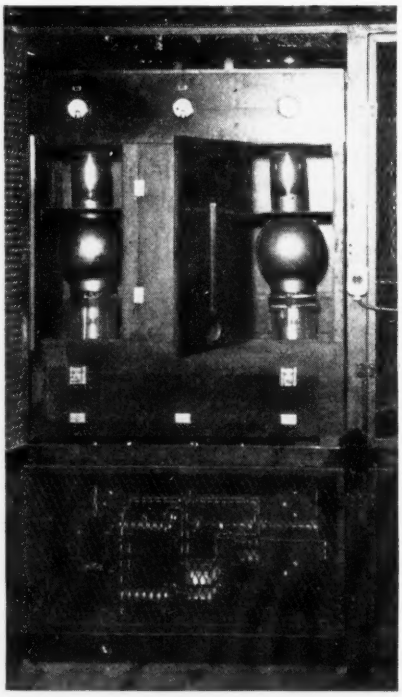
Two new accomplishments with electron tubes were announced at the recent A.I.E.E. winter convention: a new system of high-voltage d.c. power transmission, and a new type of d.c. motor with a stationary commutator, operating from an a.c. source

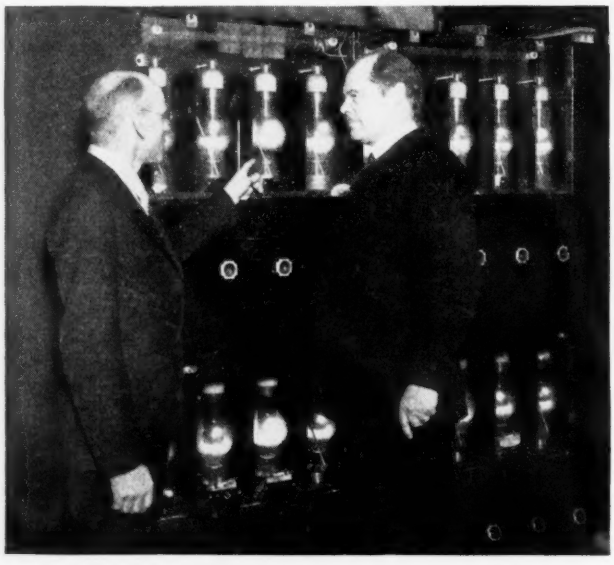
A NEW system has been developed for transmission and distribution of electric power. This has been done with electronic devices, including Thyratron and Phanotron tubes. With this system higher stability obtains than found in previous practice. Faults similar to short circuits result in reduced instead of increased power flow in the circuit involved.

The new system, constant-current, direct-current transmission, was described in a paper presented at the winter convention of the American Institute of Electrical Engineers, in New York, N. Y., Jan. 22 to 25, by Dr. C. H. Willis, of Princeton University, and B. D. Bedford and Dr. F. R. Elder of General Electric Co. Direct-current power transmission by constant current is in itself not new, but the new system does it for the first time with electronic tubes. In brief, essential features of this system are:

It is a constant-current, direct-current system in which power flow is in one direction only at the will of the operator, but can be transmitted in either direction if desired. Power flow is under control of the operator at all times. Wattless power is not transmitted. A short circuit on the system causes a reduction of power flow on the circuit involved. Power can be transmitted by either overhead or underground lines any distance. A circuit of this type can be tapped at any point to supply or take power. Like or unlike frequencies can be operated together to feed any other system of like or unlike frequencies. The system cannot get out of synchronism with the one feeding it, or receiving power.

In the paper, there was described a circuit installed in the General Electric Research Laboratory at Schenectady arranged for the transmission of 150 kw., the circuit operating at a maximum of 15,000 volts and 10 amp. In one of the factory buildings, a larger installation has been connected to a 13,800-volt, 60-cycle, 3-phase, alternating-current bus of the New York Power & Light Corp., with a circuit for transmitting a constant direct current of 200 amp. at 15,000 volts. This circuit includes about 15,000 ft. of underground conductor, and is connected back to the 13,800-volt bus, after being inverted from direct- to alternating-current of the proper characteristics.





Close-up of Thyratron tubes used to invert direct to alternating current at receiving end of line

Dr. E. F. W. Alexanderson (right) and A. H. Mittag, before part of Thyratron equipment for a 400-hp., 625-r.p.m., adjustable-speed, d.c. motor that operates on 2,300-volt a.c.

In this 3,000-kw. constant-current, direct-current circuit, a group of condensers and reactors are so connected to the 13,800-volt bus that constant-current alternating-current is obtained, the circuit being tuned so that this current is 200 amp., the voltage varying with the load. The alternating current is then rectified by means of six Phanotron tubes. If 2-way transmission is desired, Thyratron tubes are used.

If a short circuit occurs on the direct-current line, and if the constant current of the system is 200 and the regulation of the line is 10%, then the current flow into the short circuit will be about 20 amp. The voltage on the direct-current line drops to that point necessary to cause 20 amp. to flow in the short circuit.

A new type of electric motor having series direct-current characteristics that operates on alternating-current and includes a stationary commutator has been developed by E. F. W. Alexanderson, consulting engineer of the General Electric Co. This is known as a Thyratron motor and is made possible by recent advances in electron-tube applications. Announcement of this development was made in a paper by Dr. Alexanderson and A. H. Mittag.

One motor of this type, rated 400 hp. at 625 r.p.m., and 75 hp. at 350 r.p.m., intended for driving an induced-draft fan, has been built and is now on test. These are specified ranges of horsepower and speed for the particular application, although motor speed may be controlled down to standstill, if required. The equipment operates from 2,300-volt, 3-phase, 60-cycle power, and has a stationary armature and a revolving field of the type used in synchronous motors. The electron tubes perform two functions: one, commutation, and the other, grid-controlled rectification. The grid-controlled rectifier function provides the motor with continuous power control from standstill to maximum speed, without power loss in resistance.

While running from alternating current, the motor has the characteristics of a series-type, direct-current machine. Its speed is independent of power-supply frequency. Smooth control of speed can be obtained over full range.

Because of these characteristics, motors of this type are applicable to fans, centrifugal pumps, compressors and similar equipment.

THE ENGINEER'S BOOKSHELF

Marketing Equipment

MARKETING INDUSTRIAL EQUIPMENT (1935)—*By Bernard Lester. Published by McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y. 307 pages, 6 x 9 in. Cloth covers. Price, $3.50.*

This book is, of course, not an engineering treatise, but one dealing with marketing and selling. The subject, however, particularly when applied to industrial equipment, is of great interest to many engineers, especially engineering executives. Mr. Lester, assistant sales manager of the Industrial Department of Westinghouse Electric & Mfg. Co., started, in 1931, to give a course at the University of Pittsburgh, dealing with sales and service of industrial equipment. This book is the outgrowth of his course.

Subjects covered include: the development of industry, character and extent of the industrial market, production machinery and equipment required by industry, analysis of products, markets, competitors and distribution, distribution of machinery and equipment, sales expense, sales organization, operation of the field sales organization, customer analysis, specifications and proposals, sales promotion, industry co-operative efforts, future markets and marketing tendencies.

A.S.H.V.E. Guide

A.S.H.V.E. GUIDE (1935)—*Published by American Society of Heating & Ventilating Engineers, 51 Madison Ave., New York, N. Y. 1024 pages, 6 x 9 in. Flexible covers. 224 pages catalog data. Price, $5.*

This is the thirteenth edition of this reference book and text, this year compiled by more than 200 engineering specialists. Three divisions comprise the work. Technical data covers 706 pages and include 41 chapters covering heating, air conditioning, cooling, insulation and ventilation from both theoretical and practical aspects. The second section includes problems in practice, in the form of questions and answers, plus an inserted psychrometric chart. There are also included data and a roll of membership of the Society.

Brief Reviews

AXIALGEBLASE VOM STANDPUNKT DER TRAGFLÜGELTHEORIE. (*Axial-flow fans from the Standpoint of Wingtheory*) (1935) *By Dr. C. Keller, Dip. Ing. Published by A. B. Gebr. Leemann & Co., Zurich, Switzerland. 187 pages, 7 x 9½ in. Paper covers. Illustrated*—This book (in German, of course) is a highly technical treatise, elaborately implemented with experimental data. It deals with radial-vane fans from the standpoint of aerodynamic theory, and will be of interest only to the designers, experimenters and research men in organizations building equipment using such vanes.

A.S.T.M. STANDARDS ON COAL AND COKE. *Prepared by Committee D5 on Coal and Coke. Published Sept., 1934, by American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa. 108 pages. Paper cover. Price, $1.*—First compilation of all standards and tentative specifications of tests for coal and coke, include five specifications and 13 methods of tests and standard definitions of terms relating to coal and coke.

A DISCUSSION OF ECONOMIC PRINCIPLES OF UNDERLYING ELECTRICITY SERVICE AND RATES. *Published by Montreal (Que.) Light, Heat & Power Consolidated, 44 pages, 5½ x 8 in., and French translations. Paper covers.*—Free.

UNDERFEED COMBUSTION, EFFECT OF PREHEAT AND DISTRIBUTION OF ASH IN FUEL BEDS. *By P. Nicholls, Bulletin 378 of the Bureau of Mines, U. S. Department of the Interior. 76 pages, 5½ x 8½ in. For sale by the Superintendent of Documents, Washington, D. C. Ten cents.*

WATER AS AN ENGINEERING AND INDUSTRIAL MATERIAL. *By Sheppard T. Powell. 45 pages, 6 x 9 in. Paper cover. Price $0.50.* This pamphlet gives data on removal of suspended solids from water, effect of color on industrial water supplies, and detrimental effect and removal of manganese. Considerable portion of the material discusses treatment of water for use in boilers.

LEFAX. *Fillers from Lefax (Inc.), Philadelphia, Pa., for inclusion in standard Lefax handbook.*—New titles include Order 34-35, "Belt Length & Belt Speeds on Motor Drives," Order No. 34-32, "Properties of Solid and Saturated Carbon Dioxide," Order No. 34-29, "Properties of Methyl-Chloride," Order No. 34028, "Simplified Check for Heat Value of Coal," Order No. 3505, "Heat Content of Petroleum Liquids, Vapors and Asphalt," No. 34-18, "Preparation of Analytical and Special Reagents," No. 34-6, "Organizing a Xomplete Industrial Safety Program."

PERFORMANCE EXPECTANCY OF DOMESTIC UNDERFEED STOKERS FOR ANTHRACITE. *By Allen J. Johnson. Published as Technical Publication No. 068 of the American Institute of Mining & Metallurgical Engineers, 29 West 39th St., New York, N. Y. 16 pages, 6 x 9 in. Paper cover.*

FLOW OF GAS THROUGH COAL. *By S. P. Burke and V. F. Parry. Technical Publication No. 607 of American Institute of Mining & Metallurgical Engineers, 29 West 39th St., New York, N. Y. 15 pages, 6 x 9 in. Paper covers.*

TWENTY-SEVENTH ANNUAL REPORT OF PASADENA'S MUNICIPAL LIGHT AND POWER DEPT. FOR 1933-1934. *Published, 1934, by City of Pasadena, Calif.*—This paper-covered, 39-page report is an analysis, mainly financial, of the operation of the municipal plant and system, and includes, in its tables and charts, information that should be of interest to those studying the operation of such systems.

WATER POWER RESOURCES OF CANADA (1935). *Published by Dominion Water Power and Hydrometric Bureau of the Department of the Interior, Quebec, Canada. Bulletin No. 1813 comprises 10 mimeographed pages with three tables and a diagram showing growth of Canadian water power since 1900.*—Copies free.

FEDERAL POWER COMMISSION RATE STUDY (1935). *A 73-page mimeographed report released for publication Feb. 4.*—Includes data on rate and rate comparisons, lowest and highest bills, typical bills in cities of various sizes, ranks of cities of various sizes, and summarizing data. Copies available form the Commission on request.

LUBRICATING OIL TESTS—A PRACTICAL INTERPRETATION OF THEIR SIGNIFICANCE. *Bulletin No. 33 of Engineering Extension Division Series, Virginia Polytechnic Institute, Blacksburg, Va.*—By James I. Clower, assistant professor of machine design. This 41-page, paper-bound bulletin has been published as the September, 1934, number of the "Bulletin" of the Institute.

INDEX TO A.S.T.M. STANDARDS AND TENTATIVE STANDARDS AS OF JAN. 1, 1935. *Published by American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa. 142 pages, 6 x 9 in., paper covers. Free.*—All A.S.T.M. specifications and tests are listed under appropriate key words, and items under particular subjects are arranged alphabetically, according to significant wording and title, thus facilitating use of the index. A list in numeric sequence of the serial designations is also included.

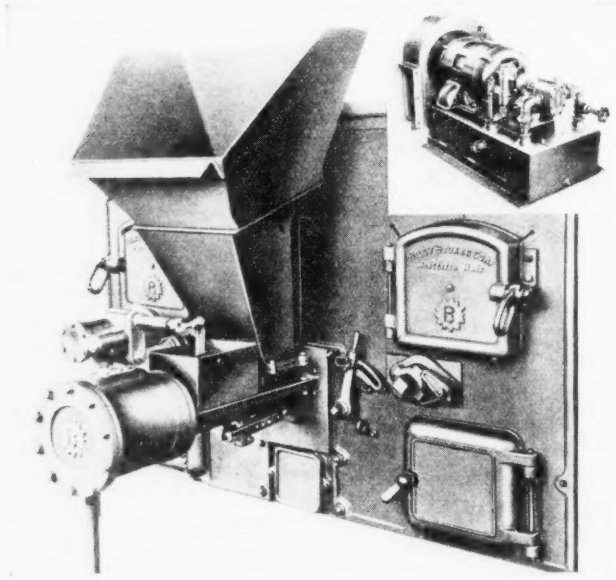
UNBALANCE IN ALTERNATING-CURRENT ROTATING MACHINES. *By E. M. Sabbagh. 96 pages, 5½ x 8½ in. Paper covers. Published as Research Series No. 45 of the Engineering Experiment Station, Purdue University, Lafayette, Ind. 50 cents.*

GAS, COKE AND BYPRODUCT-MAKING PROPERTIES OF AMERICAN COALS AND THEIR DETERMINATION. *Monograph 5 of the U. S. Department of the Interior, Bureau of Mines. By A. C. Fieldner and J. D. Davis, 164 pages, 6 x 9 in.*—Printed by American Gas Association, 420 Lexington Ave., New York, N. Y.

Correction

L. J. Richards, chief engineer, Dow Chemical Co., has called our attention to an error in the equipment data for his plant shown in the table of New Plant Construction, pages 4 and 5, in the January number. The 2,000-kw. back-pressure unit reported was installed in 1930 and operates at 350 lb. pressure and 700 deg. A new 2,500-kw. condensing unit bleeding at 10 lb. gage was ordered in 1934 and is expected to go into operation this year. It will operate at 350 lb. pressure and 725 deg. The new boiler installed last year has a capacity of 350,000 lb. of steam an hour instead of 35,000 lb. reported.

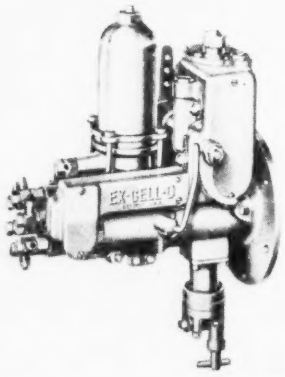
WHAT'S NEW IN PLANT EQUIPMENT



HYDRAULICALLY DRIVEN SIDE-DUMP STOKER

JONES stoker is simple, dependable, rugged, electrically driven, plunger type. Moving parts are: piston direct-connected to coal plunger, operating valve and pusher rod. Gears, sprockets, etc., eliminated. Actuates plunger with quick forward thrust. Coal feed easily regulated. Power unit (upper right in illustration) consists of oil reservoir tank upon which is mounted compact motor-driven pump and forced-draft fan unit. This unit can be put wherever space is available.

Riley Stoker Corp., Worcester, Mass.



DIESEL FUEL-INJECTION PUMP

EX-CELL-O pump, Model A, has governor, filter and fuel pump as standard accessories. Designed for diesels up to 200 hp., or 26 to 260 cu.in. piston displacement. Flange-type mounting (shown) for motive power or production installations, base-type for test purposes. 4- or 6-cyl. engines. Two principal mechanisms are driving and hydraulic units, first consisting of pump body containing plunger operating parts and mounted directly on and driven by the engine. Hydraulic unit is *replaceable* precision assembly which meters and compresses exact and controllable quantity of fuel for each cylinder. Unit light, compact and rigid, self-lubricating, requires no adjustment of fuel distribution, gives quiet idling, greater maximum power, dirt- and tamper-proof, easy to maintain and service. Pump is swash plate design. Folder No. OG-9022 or Manual No. 12.

Ex-Cell-O Aircraft & Tool Corp., 1200 Oakman Blvd., Detroit, Mich.

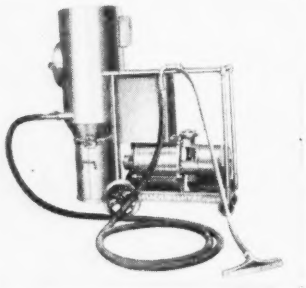
VARIABLE-SPEED MOTOR

"VARIDRIVE" motor has new lever-arm construction for larger horsepower ratings. Combines constant-speed motor, variable-speed device and gear case in unit. Eliminates mounting bases, transmissions, etc. Speed change obtained by micro-speed control which varies effective driving diameter of disks which expand and contract for higher and lower speeds, transmitting power through "Varibelt" to takeoff shaft. Unit can be direct-connected to the driven machinery. Bulletin.

U. S. Electrical Mfg. Co., 1579 S. Western Ave., Chicago, Ill.

PORTABLE VACUUM-CLEANING SYSTEM

EXIDUST heavy-duty Model MOH (illustrated) made in six sizes with 1½ to 10-hp. motors built in. Utilize 2 or 3-phase, 60-cycle a.c. Used where conditions do not warrant installation of stationary system. Incorporate multi-stage centrifugal fan-type exhauster,



cast aluminum and cast iron construction. Ball bearings. Impellers aluminum alloy 1-piece castings, balanced. Truck chassis of welded tubular steel. Lower compartment of tank is for centrifugal separation, filters in upper compartment give practically 100% cleaning. Quickly detachable storage can. Proper cleaning tools included, also toolbox. Also in medium-duty model in two sizes and heavy-duty model FB in six sizes.

Allen-Billmyre Corp., South Norwalk, Conn.

HIGH-SPEED OIL SEAL

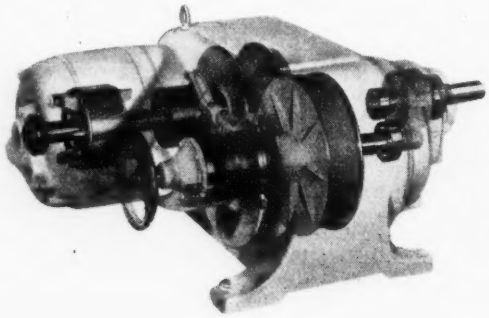
SIZES ¼ to 4 in. diameter by $\frac{1}{16}$ in., two styles, DM with flange and DP without flange. Seal consists of housing, diaphragm and seal ring of special bronze. Small compression rings in housing hold seal ring in tension with contacting face of ball race. To avoid torsional strain, all sizes above 1 in. have guide pins sliding in wells. Diaphragm clamped to housing and seal ring and is heat resisting to 220 deg. F. constant or 275 intermittent.

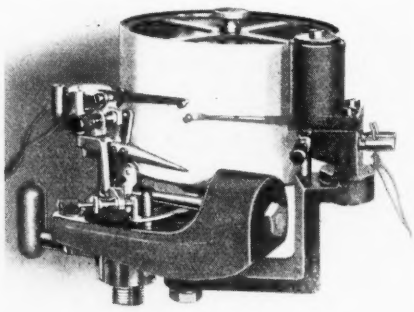
Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave., Chicago, Ill.

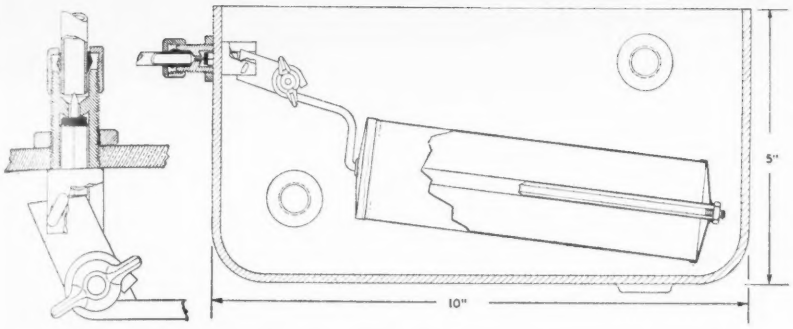
PRESSURE-TIME INDICATOR FOR HIGH-SPEED DIESELS

PRESSURE-time drums are now available for all types of Maihak indicators, including high-speed unit. Substitution of cantilever for usual helical spring reduces inertia of moving parts and permits unit to be used at engine speeds to 2,000 r.p.m. Indicator regularly furnished with piston of ½ sq.in. area, and springs calibrated for this piston available from 36 to 1 lb. per sq.in. per 1 in. card height. Time drum regularly furnished with clockwork to give chart speeds of 150-450 f.p.m., and adjustment provided for four intermediate speeds. Rotation of drum practically uniform, obtained by built-in centrifugal governor. Adjust governor to subject clock mechanism spring to load necessary to produce required speed. Space on chart which a certain pressure event occupies is determined by drum speed and is expressed in ft. of chart per min. For greatest accuracy in pressure-event timing, drum can be provided with a time marker, shown at right. Consists of calibrated leaf spring maintained in vibration by means of 8-volt d.c. electromagnet. Stylus on tip of spring draws on rotating drum the time-reference graph as a sine wave. Electromagnetic marking device optional which will keep continuous record of dead-center positions. Shown at left above pressure indicating mechanism.

Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.







AUTOMATIC WATER TENDER

UNIT holds any desired water level within very close limits. Easily installed in any position, adjusted without tools, easy to clean, will not wire-draw, stick, splash or chatter. Silent valve without springs or balls. Unit shown with special narrow balance tank, only 3¼x5x10-in. overall, also close-up of valve.

Humidity Headquarters, 1893 East 55th St., Cleveland, Ohio.

STAINLESS-CLAD WELDING ELLS

FORMED from a ply plate having thin inner or outer (as desired) surface of 18-8 stainless steel on carbon steel foundation. Longitudinal weld made with stainless rod on stainless face, high-tensile rod on carbon steel face. Also stainless-clad pipe.

Midwest Piping & Supply Co., Inc., 1420 S. Second St., St. Louis,

HIGH-VACUUM PUMP

DOUBLE-acting single vertical pump in either one or two stages, depending upon degree of vacuum. Running parts operate in air-tight, dust-proof case. Adjustments provided for wear as in large-size units. All lubrication force-feed. Feather valves. Bulletin L-700-B1.

Worthington Pump & Machinery Corp., Harrison, N. J.

QUICK-SETTING ACIDPROOF CEMENT

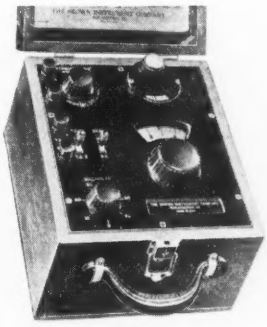
SAUER-EISEN acidproof cement No. 21 will set in 36 hr. Mixed with water to creamy consistency; hardens to porcelain-like structure resistant to water, fumes and many solvents, also fire. Will stand 2,000 deg. F. Initial "set" in 1 hr.

Technical Products Co., Pittsburgh (15) Penna.

GENERATOR VOLTAGE REGULATOR

COMPLETE line of a.c. and d.c. generator voltage regulators. Consist of four types of exciter field rheostatic units, Types GDA and GFA-4 for application to a.c. units, Types GDD and GFD-2 for d.c. GDA and GDD are direct-acting, i.e., have rheostatic element as integral part of regulator unit, actuated directly by voltage sensitive regulating device. No vibrating contacts in any type, since voltage-sensitive element is a torque motor balanced against a spring and controlled by generator voltage. Setting does not change unless voltage changes. In GDA and GDD, dashpot linked to moving element prevents oscillation and provides dead-beat operation. Other two types have magnetic damping device.

General Electric Co., Schnectady, N. Y.



PORTABLE POTENTIOMETER

PORTABLE potentiometer designed to enable pyrometer users to check their potentiometers, millivoltmeters and thermocouples quickly and accurately. The combination of a step-switch and slide wire makes it possible to read the indicating scale to .01 millivolts over a total range of 71 millivolts. The indicating scale is 17 in. long, making the smallest scale division over 1/16 in. in width. Fully enclosed, suspension type Galvanometer has a very short period so readings can be taken rapidly. Two sets of binding posts and a toggle switch, provided for thermocouple checking, further facilitate taking check readings quickly and accurately.

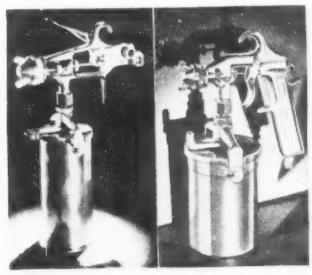
In addition, this new portable potentiometer can be used as a measured source of E.M.F. in checking recording potentiometers of the self-balancing type.

Brown Instrument Co., Philadelphia, Pa.

SOLENOID WATER-TIGHT SWITCHES

TYPE B, water-tight, weatherproof inclosures have been put on, Bulletin 709, solenoid-operated across-the-line switches having polyphase ratings up to 15 hp. 110 volts, 30 hp. 220 volts, and 50 hp. 440 to 550 volts, and for single-phase motors of self-starting types. Inclosure is cast iron, cadmium plated. Rubber gasket between cover and base. Top and bottom of base tapped for threading in conduit. Double-break silver alloy contacts. Soldered-type overload relay can be reset without opening cabinet.

Allen-Bradley Co., 1311 South First St., Milwaukee, Wis.



PAINT SPRAY GUN

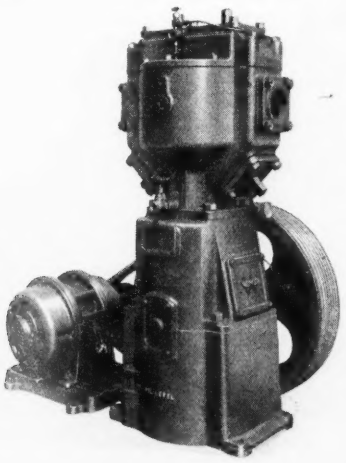
"THOR" Models 5 (left) and 6 have spray adjustable while in use. No. 5 for touchup and shading, No. 6 for touchup and general service. No. 5 has overhead trigger; No 6 conventional pistol grip. Give better atomization than former models.

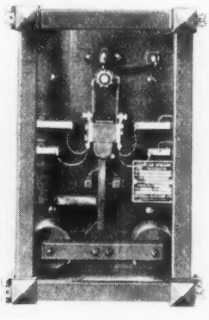
Binks Mfg. Co., 3140 Carroll Ave., Chicago, Ill.

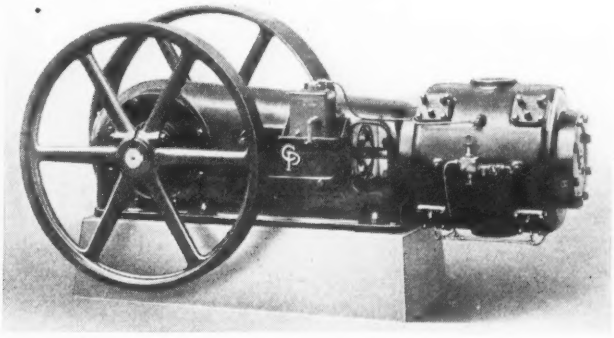
HORIZONTAL SINGLE-STAGE COMPRESSORS

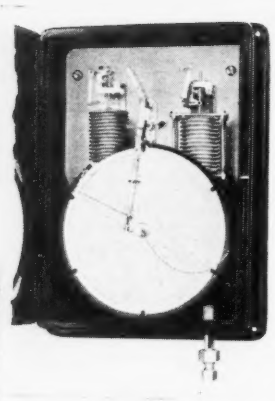
TYPE T, horizontal, single-stage compressors have roller bearings, completely inclosed frames, bored and ground crosshead guides, solid crossheads, fork-end wedge-adjustable connecting rod, double counterweighted crankshaft, large air passages, and water-jacketed cylinder and heads. Either belt or direct-connected drive for permanent or semi-permanent installation, and for compressing air or commercial gases. Uses company's "Simplate" valve. Cylinder sizes from 6 x 7 to 20 x 13 in., speeds from 400 down to 275 r.p.m., giving piston displacements 89 to 1,293 c.f.m.

Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y.









RECORDING ABSOLUTE-PRESSURE GAGE

THIS direct-reading instrument is a recording vacuum gage compensated for changes in barometric pressure and in temperature. Has two measuring elements coordinated through special differential transmitting linkage. One element connected to vacuum line, other functions in connection with compensating element. Furnished for ranges as low as 25 mm. head of mercury absolute pressure or equivalent. Rectangular wall or flush case.

Bristol Co., Waterbury, Conn.

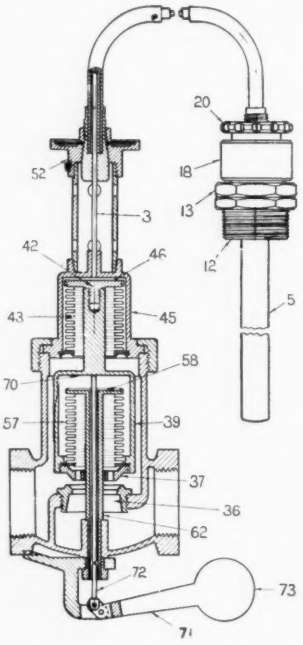
6-CYL., 2-STAGE, WATER-COOLED COMPRESSOR

THIS unit uses four small-diameter low-pressure cylinders instead of two large ones, thus attaining small lightweight pistons and reducing inertia load. Two pairs of low-pressure, water-cooled cylinders provide lower air temperature and thus save power. Water-cooled cylinder walls give lower wall temperature, better lubrication and longer life, as well as avoiding distortion. These 6-cyl. units are compact, with efficiencies comparable to those of large, two-stage horizontal units of same capacity. Can have motor mounted on shaft, V-belt to electric motor, diesel or gasoline engines, or direct-connected to flexible flywheel coupling, to motor or engine.

Gardner-Denver Co., Quincy, Ill.

SELF-ACTING TEMPERATURE REGULATOR

LESS than 1-deg. variation in temperature will move valve disk of this unit with proper throttling action from open or closed position. Most of throttle energy is obtained from heat energy of steam in valve body, less than 1 per cent being taken from thermostatic bulb. Packless and balanced-valve constructino. Valve body bronze, other parts brass or other non-corroding material. Valve disk 37, seat ring 36, and central guide pin 62 for disk are Monel metal. Balancing includes two flexible metal bellows 43 and 57, each with effective area equal to or larger than opening in 36. With valve opened or closed, pressure inside valve body against movable wall 42 is always balanced by pressure against effective area of wall 70 or on casing 39, inside of which is exposed to atmosphere through hole in guide stem 62. Valve disk perforated to allow steam to circulate inside bellows 57 and against stationary wall 58, thus avoiding additional unbalanced area exposed to steam pressure when valve is open. Bellows 43 and casing 45 form vaporizing chamber connected to thermostat through capillary tubing 3. Thermostatic bulb 5 and capillary tubing are normally filled with suitable liquid, while partial vacuum exists in chamber 46. Slight variation in temperature of thermostatic bulb 5 moves liquid from rleatively cool part on one side of flange 52 to vaporizing temperature inside 46, where it flashes into vapor and expands more than 500 times to close valve. Lever-action unit shown. Action instantaneous. Regulator will withstand over 100 deg. overload; range is 40 deg. Temperature adjustment by locknut 20, and adjusting nut 18, which changes volume of thermostat 5. Hand-adjusted over entire range of 40 deg. in less than 10 sec.



Emil T. Johnson Regulator Co., 6435 N. Talman Ave., Chicago, Ill.

GOGGLES

DURALITE-50 hot-worker's goggle doubles area usually allowed for ventilation. Extra ventilation behind lenses keeps them free of fog or steam, and aids in keeping area around eyes cool. Special lenses and frames.

American Optical Co., Southbridge, Mass.

VOLATILE LIQUID PUMP

TYPE "T" turbine pump with priming chamber including integral by-pass and relief valve. Inherent high vacuum facilitates self-priming. Several sizes ranging from 20 to 350 g.p.m. Quiet and vibrationless operation, low internal friction and power consumption. Bulletin 260-B12.

Roots-Connersville Blower Corp., Connersville, Ind.

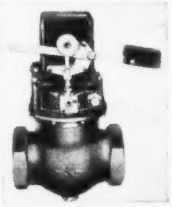
PIPE CUTTERS

No. 102 Beaver square-built wheel cutter is obtainable in either 1- or 3-wheel designs, and for cutting $\frac{1}{8}$- to 2-in. pipes. No. 204 is in 3-wheel type only, for cutting $2\frac{1}{2}$- to 4-in. pipe. Units of malleable iron with all parts at exact right angles. Wheels available for cutting standard pipe, cast iron pipe or thin-wall tubing. Interchangeable.

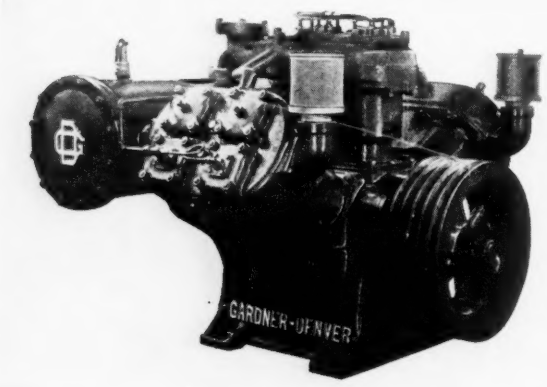
Beaver Pipe Tools, Inc., Warren, Ohio.

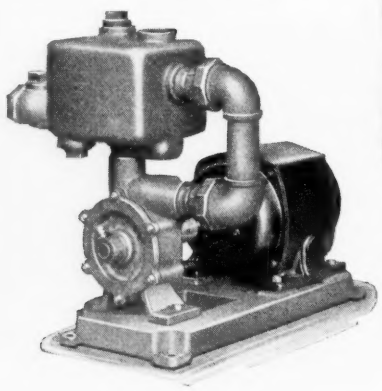
SLOW-OPENING GAS VALVES

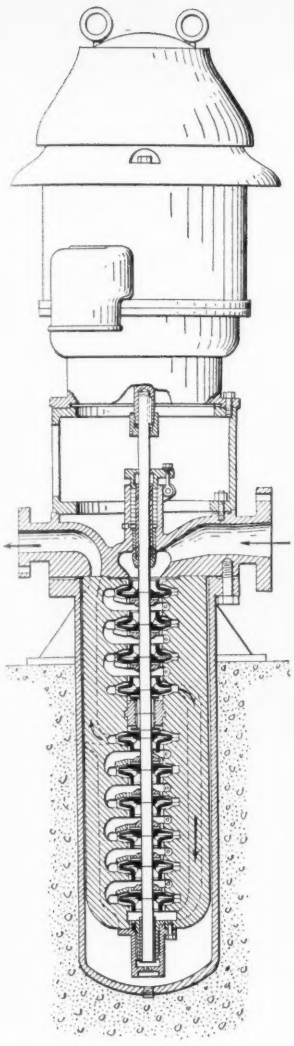
SIMILAR to company's MHR valve and motor equipment. Time of opening about 30 sec. and closing 3 sec. Motor operates valve through opening cycle; 50-lb. external spring in holder alongside of adapter rotates motor backwards to close valve. Adapter includes adjustable flare pilot with bypass adjustment for on-off or low-high-low service. Flare pilot valve always opens before opening of main gas valve and closes after main valve opens. Same action on closing cycle. Separate gas inlet to flare pilot valve from piping ahead of gas valve if pilot flame has tendency to be smaller than is practical. Damper lever arm and flare pilot operated from cam on motor crankshaft. Counter-balance weight on damper arm may be at either end of damper level arm to provide either direct or reverse action. Valve sizes $1\frac{1}{2}$, 2, $2\frac{1}{2}$ and 3 in. are straight-through screwed type with bronze bodies, 3-, 4- and 6-in. sizes iron straight - through flanged type. All sizes relief type with small valve built in top of main valve. 3 lb. pressure rating up to 3-in. size, 1 lb. rating for 4- to 6-in. sizes. Provision made for operating valves manually during power failure and an automatic recycling feature returns valve to command of controller when current service is restored. Bulletin No. 7-306.



Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.







HIGH-LIFT PUMP

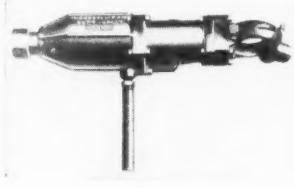
"HYDROPRESS" centrifugal pump will build up pressures to 2,800 lb., in capacities from 10 to 250 g.p.m. Four standard sizes, 8, 10, 12 and 15 in. Number of stages ranges from 4 to 54, depending on conditions. Provides high-pressure or high-lift water supply. Bulletin available.

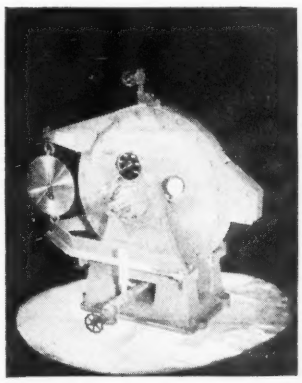
Byron Jackson Co., Dept. 57, Berkeley, Calif.

PNEUMATIC WRENCH

POTT impact wrench weighs about 20 lb., and will spin down 1-in. or larger nut at 700 r.p.m., and give it a series of smart torsional blows at 1,400 per min. to tighten it as securely as desired. Uses cylindrical block of special rubber, interposed between multi-vane air motor and chuck, and called an "accumulator." In operation, motor torque is applied to accumulator, which in twisting is shortened, lifting hammer from engagement with anvil. Hammer is then released and spun forward to the next engagement, thus delivering blow to anvil, on end of which chuck is attached. These torsional blows exert more powerful turning effect than is possible with other portable wrenches. This action also makes it possible to remove nuts formerly not removable, except by splitting or burning. Operable by one man. Pamphlet No. 2152.

Ingersoll-Rand Co., 11 Broadway, New York, N. Y.





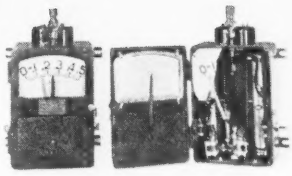
DYNAMOMETER

"TORQUE" dynamometer is of hydraulic absorption type for measurement of torque and horsepower of gas, gasoline, oil or diesel engines or electric motors, steam and hydraulic turbines, water wheels, speed reducers, etc. Claimed as smooth and accurate as electrical types, while more flexible and lower priced. Stator within which one or more rotors of special construction rotate. Absorption medium is water, power being dissipated in heat, under control. Both stator and rotor mounted on annular ball bearings. Scale equipment, connected to floating stator, measures torque applied to rotor shaft in either direction of rotation. Water consumption nominal. Sizes to meet any testing requirement.

Torque Products Co., 875 E. Lake Forest Ave., Milwaukee, Wis.

DRAFT GAGES

"DRAFTROL" for indicating and controlling draft pressure or flow of gas or air, combines indicating draft gage of pointer type with draft controller. Furnished with or without indicating pointer, and with one or two non-tilting mercury switches for either high or low electric contact or both. Open tungsten or silver contacts. Unit compact and dependable. Simple mechanism



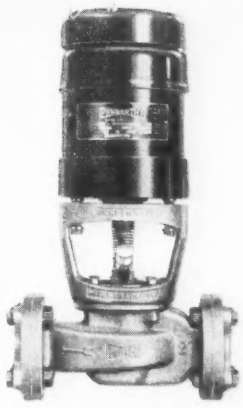
with slack leather diaphragm replacing oil, floats and inverted bells. Cast aluminum case. Light-weight interior parts. Minimum friction, any degree of sensitivity required. Bull's-eye light to attract attention if desired. Lug or flush mounting. Standard scale ranges for draft in in. w.g. are: 0.3 0.5, 1, 2, and 5. One balanced range also: —0.1 to 0 to —0.4 in. Special ranges with hand-drawn scale. Slack leather diaphragm unit in ranges from 1/10 in. to 100 in. water, and sensitivity as required. Higher pressure ranges employ metallic bellows or Bourdon tubes.

Hays Corp., P. O. Box 299, Michigan City, Ind.

AIR OR GAS COMPRESSOR

CLASS 3-AT, single-stage, straight-line, Timken roller-bearing compressor is of horizontal double-acting type adapted for heavy-duty service in sizes from 5 to 125 hp., and pressures from 12 to 150 lb. Bearings mounted in heavy housing on each side. Distance piece or auxiliary stuffing box between cylinder and frame prevents oil from passing over and gives free access to packing gland. Free access to working parts through oil-tight latched covers. Steel forged connecting rod. Crankpin box cast steel, lined with babbitt, while cross-head pin box is phosphor bronze. Box adjusted by wedge block. Air-cushion valves. Continuous automatic lubrication. Drive by short or long belt, or multiple-V, with motor overhead, in same plane, or direct-connected. Automatic stop and start control, or choking intake or by-pass unloaders for continuous operation, if desired.

Pennsylvania Pump & Compressor Co., Easton, Pa.



WATER CIRCULATOR

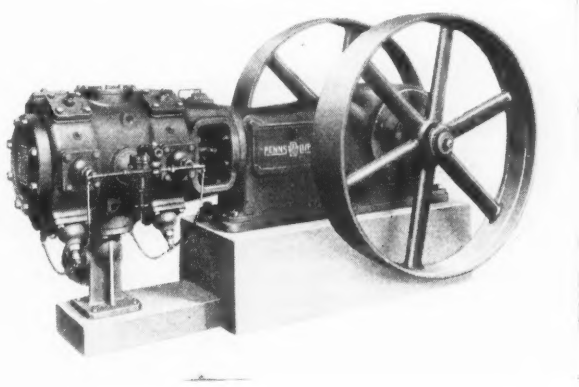
FORCES heated water from the hot-water heating boiler throughout system whenever motor is started, thus avoiding delay in heat delivery encountered by gravity system. Faster flow through piping claimed to minimize heat transmission loss and increase rate of heat transfer. Also will circulate water to radiators below boiler room level or to remote radiation with smaller pipe sizes. Centrifugal pump unit bronze, driven by 110-volt condenser start-and-run single-phase motors. All moving parts sound insulated; motor spring-mounted and flexible-coupled to impeller. Monel impeller shaft in bronze bearing. Three sizes, capacities of 1,250 to 6,000 g.p.h. against 1-ft. discharge head.

Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.

SEALED CAPACITORS

HALF size, one-third weight of conventional oil-filled units, these hermetically-sealed power capacitors impregnated with fireproof "Inerteen," are housed in voltage cases of sheet steel with solder-seal porcelain and terminal bushing. Also new design welded rack frames or cabinets for any mounting, including pole. Any size capacitors available from 5 kva. and 230 volts up to 1,200 at 6,900 volts.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



A.S.H.V.E. at Buffalo

REPORTS PRACTICAL TESTING

AT THE 41st annual meeting of the American Society of Heating & Ventilating Engineers, at the Statler Hotel in Buffalo, Jan. 28, 29 and 30, were presented twelve technical papers, together with reports of committees. John Howatt was elected president, G. L. Larson first vice-president, D. S. Boyden second vice-president, and A. J. Offner secretary.

Although the meeting brought forth no new trend in heating or air-conditioning practice, it was noteworthy for the papers reporting performance and comparative data on heating and air-conditioning systems in commercial operation. About half of the technical papers contained information of interest to power engineers and are briefly abstracted here.

A paper by Professor Estep, reporting results of studies on the ash in coal, was read by L. A. Harding. It is usually stated that coals having ash fusion temperatures below 2,400 deg. F. are clinkering coals, and above this figure they are non-clinkering. This is purely an arbitrary dividing line and has little bearing on the question as to whether or not a coal will produce clinkers. Examination of ash will show that although there may be no clinkers, nearly all of the ash has fused.

Many believe that coal which is high in total sulphur will cause considerable clinkering formation. This idea is wrong. Sulphur appears in coal in two forms, organic and inorganic, and the relative proportions of these two forms vary within wide limits. The only bad effect from organic sulphur is atmospheric pollution, and it has no effect whatsoever on the behavior of ash. Inorganic sulphur, usually appearing in the form of iron pyrite, may or may not lower the fusion temperature, depending upon whether it is burned in an oxidizing or non-oxidizing atmosphere.

Experiments on the effects of mixing coals on the ash fusion temperature showed that 60% of the mixtures tried resulted in a lowering of the fusion temperature, in some cases as much as 400 deg., while the increase in the other 40% was small, usually less than 100 deg.

F. C. Houghton reported work done by the A.S.H.V.E. research laboratory to obtain data for estimating the required capacity of units used in air-conditioning single segregated offices in modern office buildings. The work was carried on in three rooms on the 27th floor of the Grant Building, Pittsburgh, during the summer of 1934.

The three rooms had northeastern, northwestern and southwestern exposure, and were chosen because they had been used in earlier laboratory work. Results of the study clearly indicated that with the acceptance of present standards for indoor cooling temperatures, the main factor in the maximum cooling load is the high rate of heat transfer from the surface of walls, ceiling and floor to the cooled air of the room, and that the peak requirements take place soon after the beginning of the cooling period.

The outside temperature basis for present cooling temperature standards is bound to have a large bearing on maximum cooling rate, and a lesser effect on the total cooling load for the day. Acceptance of building corridor temperature instead of outside temperature as a basis for determining required room temperature is shown to have inherent advantage in giving a more desirable indoor temperature, besides the material advantage of reducing peak cooling load.

For conditions of construction and exposure in the Grant Building the solar radiation had little effect on the peak cooling load for the day.

Discussion brought out that outside temperatures were obtained from thermocouples not shielded, that there was very little furniture in the room during this test, that the air-conditioning unit did not force air current to the ceiling, that the air leaving it was directed at an angle so that it would carry as far as possible into the room. Professor Harding observed that the cooling load held closely to 2½ B.t.u. per cu.ft. average.

Minimum Ventilation

Ventilation box experiments, made at the Harvard University School of Public Health in a study of minimum ventilation requirements, were reported in a paper by W. H. Lehmberg, A. B. Brandt, and Kenneth Morse. Purpose of the work was to study the relationship between intensity of body odors in an occupied space and quantity of fresh air supplied, the factors affecting odor intensity and the possibility of using odor intensity as an index of minimum ventilation requirements.

It was found that the minimum outdoor air supplied per person necessary to prevent accumulation of objectionable body odor in the air of the box varied from 13 to 27 c.f.m.

A paper of particular value to building operators was that presented by J. H. Walker and C. H. Tuttle on "Heat Requirements of Buildings." This paper reported the steam consumption statistics of 163 buildings divided among 21 different cities in the United States. These data were presented in the form of steam consumption per degree-day per 1,000 sq.ft. of equivalent installed radiator surface, per 1,000 cu.ft. of heated space, and per 1,000 B.t.u. of calculated heat loss. In addition, comparisons were made of steam consumption before and after installing temperature control equipment, building load factor and maximum demands. Typical heating load curves were shown, and information given on load factor, maximum demands and hot water used by various types of buildings.

The authors recommend as a unit of comparison the heat consumption per degree-day per 1,000 B.t.u. of calculated heat loss. Data are presented to show that there is little difference between the degree-day as calculated on mean temperature and on average temperature when a year period is considered.

In discussing this paper, Mr. Close expressed his opinion that wind velocity has a large effect on heat loss and is not considered when steam consumption per degree-day is used as a base. Prof. Rowley agreed with the authors that there is little difference between using average temperature and the mean temperature for determining degree-days. He expressed the opinion that sun effects is the reason that zero steam consumption comes at 65 deg. instead of 70 deg.

Industrial Heating

G. L. Larson, D. W. Nelson and John James reported the results of tests on three heating systems in an industrial building. The tests were conducted in a 71 x 182-ft., 1-story structure. The building was originally heated by a 2-pipe vacuum system using direct radiation. This consisted of wall radiation along the walls and in trusses directly below the skylight. Total direct radiation in this system was 4,431 sq.ft. 53% of this is directly below the skylights. For test purposes, seven suspended unit heaters were installed 10 ft. from the floor. Their total capacity is 4,676 sq.ft. The third system tested consisted of two floor unit heaters of identical size and construction, total rating 910,000 B.t.u., 3,790 sq.ft. of equiv. radiation.

Two-temperature thermostats were installed on three posts on the center line of the building, to divide the space into three equal zones. An electric clock shifts the circuits between the night and day thermostats when operating on dual control.

From the results of authors conclude:

For dual control with the day thermostat set at 70 deg. for 11 hr. and the night at 50 deg. for 13 hr. the saving of steam over continuous control with the thermostat set at 70 deg. for 24 hr. was:

(*a*) For direct radiation, 15% and probably a much larger saving, had sun intensities and wind velocities been equal;

(*b*) For suspended unit heaters with fan and steam control, 30%;

(*c*) For suspended unit heaters with fan control and continuous steam, 25%.

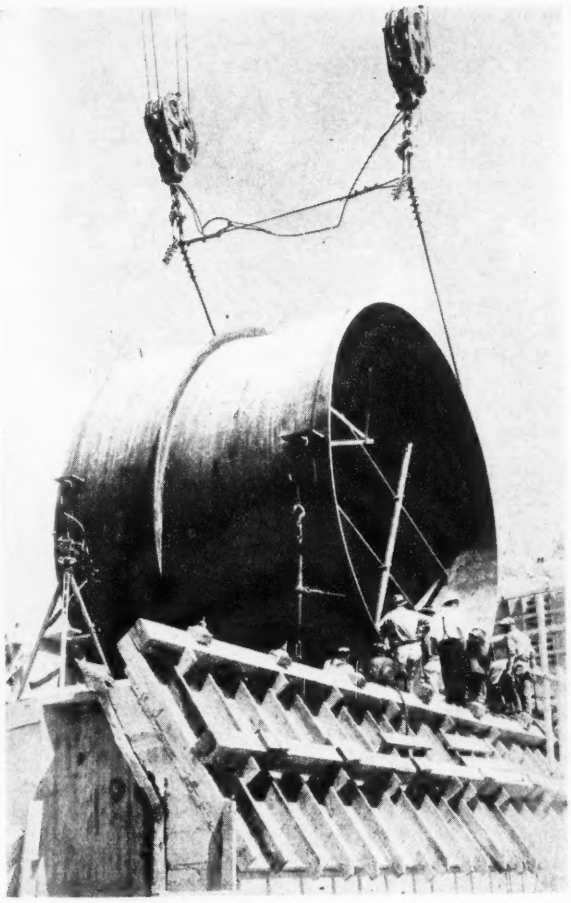
The saving of suspended unit heaters over direct radiation, both operating on continuous control was something over 13.5%, and might have been 20% had sun and wind effects been equal.

The saving of suspended unit heaters over direct radiation, both operating on dual control (70-50 deg.) amounted ot 25%.

The saving of floor unit heaters over direct radiation, both operating on continuous control was 9% and would have been higher had sun and wind effects been equal.

The saving of steam of floor unit heaters over suspended unit heaters, both operating on continuous control, was 2.3%.

The saving of steam of suspended unit heaters over floor unit heaters, both operating on dual control (70-60 deg.), was 7%.



ALL-WELDED PENSTOCK FOR NORRIS DAM

20 ft. in diameter by 1⅛ to 1⅜ in. thick, a section of arc-welded steel penstock for Norris Dam being put in position. A.S.M.E. Class 1 welding specifications were followed, shop welding being done automatically while field welding was done with the shielded arc. Norris Dam, first of six in the TVA development, will be 253 ft. high and 1,800 ft. long, with two 60,000-hp. units in the powerhouse. The penstock was built by Chicago Bridge & Iron Works, using Lincoln equipment

POWER LINES

Oil & Gas Power Meeting In Tulsa, May 8

The National Oil & Gas Power Meeting will be held in Tulsa, Okla., May 8-11, at the Hotel Mayo, it was announced by Ralph Miller, chairman of the Oil & Gas Power Division, A.S.M.E. The meeting will be held jointly with the Mid-Continent Section, which will arrange half the program. This half will deal with diesel problems of the oil fields. L. H. Morrison, of New York, will have charge of arranging the other half of the technical program, which will cover developments of national interest in the diesel field.

There will be held in connection with the meeting the usual exhibit of oil engine parts, materials and accessories. The committee in charge of the exhibit is Harte Cooke, chief engineer, McIntosh & Seymour Corp.; Lester Goldsmith, consulting engineer, Atlantic Pipe Line Co.; Lee Schneitter, plant betterment engineer, Electric Bond & Share Co., and J. F. Eaton, of the Jaracki Mfg. Co., Tulsa, Okla.

A. Ch. S. Meeting in New York, April 22

The tercentary of the American chemical industries is to be celebrated by the American Chemical Society in New York the week of April 22. As its part in the program, the Division of Gas & Fuel Chemistry is planning three days of meetings, two special sessions on Inorganic Matter in a Fuel Bed, Coal Carbonization, Anthracite, The Chemistry of Gaseous Hydrocarbons, and miscellaneous papers on gas and fuel subjects.

Committee Reports On Battersea System

An official committee has just reported on the system of treating flue gas in operation at Battersea Power Station of London Power Co. which eliminates sulphur fumes from flue gas. Escape is at present found to be about 0.03 grain of sulphur (as sulphurous anhydride) per cu.ft. As to the present concentration of sulphur gases in the flue gas the committee expresses the opinion that the company has adopted the best-known means of preventing, so far as reasonably practicable, the evolution of oxides of sulphur. On account of the thorough washing that the gas undergoes, there is no cause to fear deposition of solid matter from the chimneys. Visually, the white cloud of steam that issues soon dissipates, leaving nothing but a faint greyness, or not even this. Attempts to determine the solid matter in the washed chimney gas have so far failed to give any measurable quantity.

Hudson County, N. J., Saves $750,000 by Smoke Abatement

More than $750,000 has been saved by fuel users of Hudson County, N. J., as the direct result of smoke abatement activities, according to William G. Christy, county smoke abatement engineer. He claims that for the year 1934 the saving in fuel amounted to $223,000, plus $531,000 saved during the first three years, due to improved methods of stoking, installation of smoke-eliminating devices and equipment, as well as other changes recommended by the Department of Smoke Regulation. The annual budget of the County Smoke Bureau is $28,000, giving a return of eight times the investment.

In 1934 there were only 630 violations out of 39,829 observations made by county inspectors. This amounts to about 90% in actual smoke elimination on all classes of fuel-burning equipment.

Soviet Generates 9 Billion Kw.-hr.

The output of current for nine months by Soviet enterprises under Glavenergo (Chief Power Plant Administration) amounted to 9,425,000,000 kw.-hr., 32% more than during the same period of last year. The output during September was 1,087,000,000 kw.-hr. In spite of the fact that the monthly plan has not been fulfilled by .25%, the average daily output of this month, 38,900,000 kw.-hr., is a record figure for this year and is even higher than in the winter months, January and February.

Twenty hydro-electric power stations are to be built during 1935 to supply the needs of collective farms in Uzbekistan, by decision of the Central Executive Committee of that Republic. The power of each farm will range from 35 to 100 hp.

Paris Paper Puts in Sub-cellar Diesel Plant

The new underground diesel-electric power station of the daily paper "L'Intransigeant," Paris, is a standby station about 50 ft. below ground level. Erection of the 3,000-kw. power plant in the existing building, without any disturbance to other work, caused many difficulties.

The plant consists of two 6-cyl. 4-cycle Sulzer diesels, each developing 1,250 b.hp., driving 850 kw., 220-volt, Alsthorn d.c. generators. The machinery was installed 10 ft. below the level of the Seine and about 23 ft. below the sewers. It was therefore necessary to erect a large water-tight arch of reinforced concrete. In construction, consideration had to be paid to the foundation of the building and also to the piles, which have to bear loads up to 800 tons.

In order to damp vibration, each 125-ton engine group is mounted on a 550-ton block of concrete, in the middle of the buildings. This block is insulated by means of an anti-vibration layer.

All machinery had to be brought into the building during the night and let down through a lift shaft into the engine room. This work necessitated thorough study since in the most favorable position a clearance of

only 1 or 2 in. was available for crankshafts, flywheel halves, rotors, tanks, etc. The same conditions held also for erection, particularly for engine pistons, since the height of 21 ft. 4 in. could not be exceeded in the engine room and insertion of the pistons in the engines had to be done with the greatest consideration and care. Exhaust from the engines could only be led away from the roof and had to be absolutely colorless. In order to prevent noise and to avoid vibration caused by the intermittent exhaust, the exhaust piping is fitted with two 140-cu.ft. cast-iron silencers and an expansion vessel, and on these the vertical cast-iron pipe, 130 ft. high and 2 ft. in diameter, is set. The whole exhaust piping is insulated from the building by anti-vibration supports and cork slabs.

Industry Prefers Bank to Federal Loans

Means for financing industrial loans for machinery replacement and plant repairs would be provided through the Federal Housing Administration in a proviso in the HOLC bill now before the House Committee on Banking & Currency. James A. Moffett, federal housing administrator, believes that $1,500,000,000 can be spent quickly for this purpose. The bill would enable FHA to guarantee individual loans up to $50,000. A bank or other lending agency would have repayment guaranteed up to 20% of the total of such loans in its portfolio.

A questionnaire survey by FHA of 22,000 of the nation's 147,000 industrial plants indicates that the companies are ready to spend money but want to do it through their regular banks and private financial agencies rather than through Federal loans. RFC and the Federal Reserve Banks have only been able to place about $30,000,000 each under their loans to industry authorizations.

Gold Street Station Removes Old Units

Turbine units 5 and 6 at the Gold Street Generating Station of the Brooklyn Edison Co. are being removed because they are no longer needed. Unit No. 5, the second turbine unit to go into service in Brooklyn and one of the earliest turbine-generators in the country, is a Westinghouse machine originally rated at 7,500 kw., but later rewound and rerated to 11,000 kw. It started operation in 1906. Unit No. 6, a 12,500-kw. Allis-Chalmers machine, was installed in 1918. Between installation and retirement No. 5 generated 450,172,000 kw.-hr. of energy, while the total output of No. 6 was 189,597,000 kw.-hr. Gold Street is the second oldest of the existing generating stations on the Brooklyn Edison System. It started operation on May 20, 1900.

Chelsea Power Station Goes Out of Business

The tidewater electric steam generating plant of the Eastern Massachusetts Street Railway on Front Street, Chelsea, has been withdrawn from service after 42 yr. of operation, and is being dismantled. Energy for the operation of the Chelsea division of the railway is being purchased from the Edison Electric Illuminating Co. of Boston, Beacon Street substation. The steam plant contained ten boilers and seven generating units, five of the latter having been in use for the entire period of the plant's life, and supplying power through belted connections up to Dec. 1, the date of shut-down. A single stack served the installation and its total rating was 4,000 kw., all 600-volt direct-current output. Obsolescence of equipment and lower demands for power due to increasing use of motor coaches were factors in the change.

U. S. Potential Water Power

Revised estimates of the potential water power of the United States, prepared by U. S. Geological Survey, Department of the Interior, place the power available 90% of the time at 41,701,000 hp., and the power available 50% of the time at 60,276,000 hp. Ten leading states and their potential power in horsepower available 90% of the time are: Washington, 8,800,000; Oregon, 4,400,000; California, 4,120,000; New York, 4,034,000; Arizona, 2,759,000; Idaho, 2,550,000; Montana, 2,410,000; Utah, 1,420,000; Tennessee, 1,340,000, and North Carolina, 916,000.

Total capacity of waterwheels installed in water-power plants of 100 hp. and more, in the United States, on Jan. 1, 1935, was 16,075,307 hp. It is estimated that 80,000,000 hp. would be required to utilize all water power in the country. This represents an installation equal to about twice the potential power available 90% of the time, and one-third more than the potential power available 50% of the time. Copies of the detailed estimates may be obtained free from the U. S. Geological Survey, Washington, D. C.

Seventh International Congress of Refrigeration

The Seventh International Congress of Refrigeration will be held from June 16-20, 1936, in the Hague, Holland, according to a recent announcement. Further information on this international meeting may be obtained by addressing the American Institute of Refrigeration, 433 N. Waller Ave., Chicago, Ill., J. F. Nickerson, general secretary.

DOMINION WATER POWER & HYDROMETRIC BUREAU of the Department of the Interior of Canada, has issued its annual review of hydro-electric and water power developments throughout the Dominion during 1934. While no new large waterpower undertakings were begun, work was continued on several developments under construction, and as a result ten new installations aggregating 214,965 hp. were brought into operation during the year. This brings total installations for the Dominion to 7,547,035 hp. Copies of bulletins No. 1784 may be obtained free on application to the Director of the Dominion Water Power & Hydrometric Bureau, Ottawa, Canada.

DOMNARVET IRON WORKS, Sweden, is being electrified by Swedish General Electric Co. (Asea). Steam and motor power aggregating 21,200 hp., is to be replaced by electric transformers and electric motors and horsepower is to be increased to 33,000.

COMING MEETINGS

American Society for Testing Materials —38th annual meeting, Book-Cadillac Hotel, Detroit, Mich., June 24-28 (exhibit at same time). R. E. Hess, assistant secretary, A.S.T.M., 260 S. Broad St., Philadelphia, Pa.

American Institute of Electrical Engineers — Summer convention, Ithaca, N. Y., June 24-28. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

PERSONALS

F. A. CARLISLE has been appointed assistant plant superintendent at the 156,000-kva. Comerford hydro-electric station of the Connecticut River Power Company, a subsidiary of the New England Power Association. The McIndoes hydro-electric station on the Connecticut River below Comerford has also been placed under his supervision.

ROBERT G. HUNT, vice-president of Byllesby Engineering & Management Corporation and Standard Gas & Electric Company, after thirty-nine years of service with the Byllesby organization and predecessor companies, resigned on December 1 to retire to private life. Mr. Hunt plans to reside at Griffin, Ga., forty miles south of Atlanta.

MATTHEW HUTCHINSON, for 40 years head of the municipal lighting department, Victoria, B. C., has applied for retirement as of Feb. 28. He was appointed superintendent of electric light plant and fire alarm system in 1868. In 1912 he was appointed city electrical engineer and superintendent of the lighting department.

RAY P. TARBELL has been appointed manager of the welding division, Ideal Electric & Mfg. Co., Mansfield, Ohio. He has been in the welding industry for the past 17 years.

WILLIAM L. HARTLEY, formerly manager of the Detroit office, Link-Belt Co., 910 S. Michigan Ave., Chicago, has been made manager of foundry equipment sales, with headquarters in Chicago. Harold L. Hoefman, formerly manager at Indianapolis, succeeds Mr. Hartley as manager at Detroit. Richard B. Holmes, of St. Louis office, succeeds Mr. Hoefman, and Carl A. Blomquist, of Chicago, succeeds Mr. Holmes.

W. A. NEILL has been appointed manager of the recently formed mining and construction department of Worthington Pump & Machinery Corp., Harrison, N. J.

HENRY E. WARREN, president, Warren Telechron Co., Ashland, Mass., has been awarded the 1934 Lamme Medal of the American Institute of Electrical Engineers "for outstanding contributions to the development of electric clocks and means for controlling central station frequencies."

L. F. POWELL, formerly asst. supt. of the Unionville, Mo., municipal plant, has become superintendent of the Memphis, Mo., plant.

G. F. HOOD, manager of the Worcester plants of American Steel & Wire Co., and widely known in the power field, has been appointed vice-president in charge of opera-

tions at the company headquarters in Cleveland. He has been succeeded by Carl I. Collins, superintendent of Cuyahoga works of the company in Cleveland. J. L. Perry, former manager, Cleveland, has been elected president of Tennessee Coal & Iron Co., Birmingham, Ala.

GEO. A. ELZ, chief electrical operator, Edgar Station of Edison Electrical Illuminating Co. of Boston, has been elected chairman of the New England System Operators' Club for the year 1935-1936. William Noyes, operating engineer of Public Service Co. of New Hampshire, Manchester, has been made secretary of the organization.

E. H. CLARK, formerly St. Louis manager for Rockbestos Products Co., and for 11 years with Northwestern Power & Light Co., will represent Harnischfeger Corp. in the Middle West and Southwest territories.

H. C. GUILD has been appointed manager of the Eastern Regional Division of Vilter Mfg. Co., Milwaukee, Wis.

ELMER C. SMITH, formerly chief engineer for Cherry River Pump & Paper Co., and associated enterprises, has been named head of the Bluefield, W. Va., National Reemployment Office.

ELLIOTT EARL, Boston consulting engineer and diesel authority, has been appointed a member of the special commission established by Gov. Curley of Massachusetts to investigate possibilities of reducing electric and gas rates within the State through agreement with utilities.

OBITUARIES

AUSTIN C. PETERS, 71, for many years active in steam plant piping construction in and around Boston, until his retirement about seven years ago, died suddenly at Arlington, Mass., Feb. 5.

CHARLES VOETSCH, 57, prominent civil engineer employed by the U. S. Bureau of Reclamation, died suddenly Feb. 7 at Denver, Colo., after a short illness. German born and educated, Mr. Voetsch came to this country in 1904, where he engaged principally in design of hydraulic turbines and power plants. He had been associated at various times with I. P. Morris Co., Allis-Chalmers, and on Maddon, Boulder, Norris and Grand Coulee dams.

JOHN I. NEWELL, 50, vice-president of B. C. Electric Railway Co., Ltd., electrical engineer with the company for 28 years, died in Vancouver, Feb. 3, following a 3-day illness. Mr. Newell's death was the result of over-exertion in connection with the recent storms and floods in the Fraser Valley.

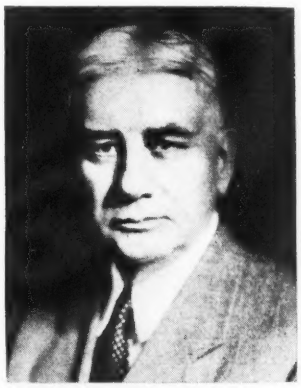
WILLIAM C. GODFREY, 78, a director of Chapman Valve Mfg. Co., and United Electric Light Co., Springfield, Mass., died there Jan. 30.

A. H. HICKERSON, 68, superintendent of the City Light & Water Works, Windom, Minn., for the past 36 years, died suddenly Feb. 1 of heart failure.

LOTT CRUMP, 66, for many years plant engineer for Lynn (Mass.) Realty Co., died Feb. 12 there.

WILLIAM F. TISDALE, 86, for many years identified with steam pump manufacture in New England, died at Wolfeboro, N. H., Feb. 7 after a short illness. He joined Knowles Steam Pump Co. at Warren, Mass., in the early 70's; and in 1897 went to Cambridge, Mass., when Blake & Knowles Steam Pump Works was organized, where he served for some time as office manager. During the war, Mr. Tisdale was production manager at the plant of the New London (Ct.) Ship & Engine Company, retiring after this connection.

WM. S. ELLIOTT, 72, president of Elliott Co., Pittsburgh, Pa., died suddenly Feb. 21, due to a heart attack. Mr. Elliott was one of the pioneer manufacturers of the Pitts-



burgh district, and in addition to being president of the company he founded, was also a director and vice-president of Lagonda Mfg. Co., Springfield, Ohio, and Liberty Mfg. Co., Pittsburgh. He founded Liberty Co., Pittsburgh, in 1901, later expanding and forming the Elliott Co., which maintains plants at Jeannette and Springfield. He was a member of the A.S.M.E., the Engineers Society of Western Pennsylvania, and the Engineers Club of New York.

L. LEE RODGERS, 57, vice-president and treasurer, National Valve & Mfg. Co., Pittsburgh, Pa., died suddenly Feb. 10. Mr. Rodgers was one of the founders of the company 27 years ago and had been connected with it continuously until the time of his death.

BUSINESS NOTES

PENNSYLVANIA WATER & POWER CO., Holtwood, Pa., is celebrating its 25th year. Founded in 1910 by J. E. Aldred and his associates, the operating company is today managed by its founders.

NATIONAL MOTOR BEARING CO., Oakland, Calif., has opened a branch office at 477 Selden Ave., Detroit, Mich., managed by Ivor J. Cottle.

MCCLAVE-BROOKS CO., Scranton, Pa., has appointed the following exclusive sales representatives: John W. Lees (New England representative), 355 Skiff St., Hamden, Conn.; Whitmore Co. (Scranton district representative), 749 Harrison Ave., Scranton, Pa.; L. B. Coppernoll, Oswego, N. Y. (Central New York State representative); W. B. McQuiston (Western Pennsylvania representative), 305 Renshaw Bldg., Pittsburgh, Pa.; Frank B. Hubbard. (Western New York State representative), 403 Bird Ave., Buffalo, N. Y.

HOMESTEAD VALVE MFG. CO., Coraopolis, Pa., has appointed the following representatives for its valves: Carey Machinery & Supply Co., 119 East Lombard St., Baltimore, Md.; L. E. Livingstone, 2012 Ward Parkway, Fort Worth, Tex.; Charles A. Randorf, 83 Delham Ave., Buffalo, N. Y.; Atkins, Kroll & Co., 260 California St., San Francisco, Calif., is exclusive representative in Philippine Islands.

PLIBRICO JOINTLESS FIRE BRICK CO., 1800 Kingsbury St., Chicago, has appointed the following distributors: Ellison & Hawes, 530 E. Main St., Richmond, Va.; Mark H. Allen, P. O. Box 227, Greenville, S. C.; Greenwade Co., Boswell, N. M., Lubbock Machine Co., Lubbock, Tex. The company is also establishing a factory branch at St. Louis, Mo., in charge of B. W. Schaefer.

AMERICAN ENGINEERING CO., Philadelphia, Pa., has appointed Boiler Equipment Service Co., 686 Greenwood Ave., N.E., Atlanta, Ga., as agents for Taylor stokers in southern territory, with R. N. Ruiter as stoker specialist in charge.

ELECTRO-MOTIVE CORP., subsidiary of General Motors Corp., has let the contract to Austin Co., Cleveland, Ohio, for design and construction of a new diesel locomotive plant to be built in the Chicago district.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., has moved its Pittsburgh office to 2037 Koppers Bldg. Guy V. Woody is manager of the Pittsburgh district.

FORD MOTOR CO. is consuming as much electric current now at its Rouge plant as it did in 1929, the previous peak year. The total is 61,000,000 kw.-hr. per month. The present V-8 car requires about three times as much electric current in its manufacture as did the old Model T.

COLLEGE OF ENGINEERING, UNIVERSITY OF ILLINOIS, through its Department of Mining and Metallurgical Engineering and Department of Mechanical Engineering, will offer another short course in coal utilization at Urbana, June 11-13, this year. There is no charge for tuition or registration. The program will be announced about April 1.

OHIO FORGE & MACHINE CORP., Cleveland, Ohio, successor to Gears & Forgings, Inc., has appointed Denton & Anderson Co., 1225 West Washington Blvd., Chicago, as representative.

S K F INDUSTRIES, INC., has opened a branch store at 407 South 4th St., Minneapolis, Minn., with A. Kishkunas in charge.

YOUNG RADIATOR CO., Racine, Wis., has appointed R. C. Overstreet purchasing agent.

E. F. HOUGHTON & CO., 240 W. Somerset St., Philadelphia, Pa., recently elected the following directors: Louis E. Murphy, Major A. E. Carpenter, George W. Pressell, Dr. R. H. Patch, A. E. Carpenter III, H. B. Fox, C. Howard Butler. Officers were re-elected.

CARIBOO HYDRO-ELECTRIC CO., LTD., 902 Royal Trust Bldg., Vancouver, B. C., has been formed to build a power plant on Swamp River, to serve mining developments

in the Cariboo mining area. D. R. Blair, 850 West Hastings St., Vancouver, has been placed in charge.

PERRY ENGINEERING CO., 154 Nassau St., New York, N. Y., has been appointed exclusive agent for sales of Leslie pressure and temperature regulators for industrial and stationary service in Greater New York and Westchester County. Leslie Co. has revised its Pacific Coast agency arrangements on regulators, governors and valves. New representatives are: Refrigerating & Power Specialties Co., 380 Brannan St., San Francisco, Calif., and 923 East Third St., Los Angeles, Calif., for the State of California. John H. Marvin Co., 1016 First Avenue,, S., Seattle, Wash., for the States of Oregon and Washington. Agencies in New York State include: Ellis E. Morse & Co., 81 State St., Binghamton; Stritt & Priebe, Inc., 42 Breckenridge St., Buffalo; Hery & Burns, 241 Cutler Bldg., Rochester; The Hopton Co., 321 Dennison Bldg., Syracuse; John A. Scanlon Supply Co., 708 First St., Utica; C. H. Wilson, 1403 Park Blvd., Troy, N. Y. (Albany district).

ERNST WATER COLUMN & GAGE CO., Newark, N. J., has moved its Austin, Tex., office to Wichita Falls, Tex., in charge of Theodore Langenbergh. Other representatives recently appointed include: H. C. Freese, 3521 Baltimore Ave., Kansas City, Mo., and H. L. Kister, 736 Carrollton Ave., Indianapolis, Ind.

E. VERNON HILL CO., 121 N. Clark St., Chicago, Ill., has opened a branch office at 822 Graybar Bldg., New York, N. Y.

STRAWS

Pointing the way business winds blow

GREAT WESTERN POWER CO. has applied to the Federal Power Commission for a preliminary permit covering a 400,000-hp. project on North Fork of the Feather River. Six power developments are proposed to utilize all available head between existing Caribou and Big Bend developments, power to be used for public utility purposes in north and central California. The applicant is a subsidary of Pacific Gas & Electric Co., which has been planning for this development for nearly 20 years.

PROPOSED amendments to the R.F.C. Act provide for a $300,000,000 fund for financing purchases of electrical, plumbing and air conditioning appliances and equipment.

ARKANSAS CITY (ARK.) Light & Water Plant was damaged considerably by fire Jan. 31. That portion of the plant providing electricity for the light and power company being practically ruined. Damage of $12,000 was covered by insurance. The plant had recently been purchased by Arkansas Power & Light Co. from Associated Utilities of Kansas City, Mo., and the owners had just completed construction of a power line from Trippe Junction which cost approximately $18,000.

IMPERIAL IRRIGATION DISTRICT, El Centro, Calif., has plans for a hydro-electric project on the All-American irrigation canal, consisting of a series of five main generating stations, with total capacity of about 60,000 kw., estimated to cost $6,600,000; expansion of diesel-electric generating plant now under construction at Brawley, Calif., for a standby unit, with installation of equipment for rated capacity of 15,000 kw., estimated to cost about $1,500,000. Financing at early date. W. S. Cone, consulting electrical engineer for District; M. J. Dowd chief engineer and general superintendent in charge of development.

CONNERSVILLE, IND., plans complete electrification of municipal waterworks, with installation of two or more diesels and accessories, five main pumping units and auxiliary equipment. Elevated steel tank and tower also proposed. Cost about $100,000. Bids at early date. John W. Moore & Son, Indiana Pythian Bldg., Indianapolis, Ind., consulting engineers.

CASPER-ALCOVA PROJECT, WYO., has been approved for construction in revised form by Secretary Ickes. Under the new plans the irrigation development will cost $20,000,000, and a PWA allotment of $12,000,000 has been made to start construction. It is planned to install a power plant eventually with about 16,000 kw. capacity.

STANDARD FUEL ENGRG. CO., 667 Post Ave., S., Detroit, Mich., has installed a new rotary dryer for refractory cement manufacture.

BOARD OF TRUSTEES, ALABAMA BOYS' INDUSTRIAL SCHOOL, Birmingham, Ala., has plans nearing completion for steam power plant for central heating, and soon calls for bids. Warren, Knight & Davis, Birmingham, architects.

KENNEBEC DISTILLERY CO., Frankfort, Ky., plans power plant in connection with multi-unit distillery. Bids on general contract at early date. Project will cost over $100,000. Carl J. Kiefer, Schmidt Bldg., Cincinnati, Ohio, consulting engineer.

MILFORD, OHIO, is considering construction of new municipal power plant, and will have estimates made at early date. Financing through Federal aid.

RED WING HEATING CO., Red Wing, Minn., recently organized, care of Albert W. Buell, Eau Claire, Wis., engineer, has plans under way for steam power plant on Levee front, Red Wing, for central heating. Franchise granted. Cost over $50,000.

GREENWOOD, MISS., is considering extensions and improvements in municipal power plant, with new turbo-generator unit and auxiliary equipment. Project to cost over $200,000. C. G. Abbott city engineer.

ST. LOUIS, MO., is projecting plans for new steam power house for central heating in downtown district, inculding distribution lines, coke manufacturing plant, and municipal gas distribution system. Cost over $25,000,000. Financing will be arranged through Federal aid. City engineering department will be in charge.

OCEAN CITY, MD., is considering municipal power plant, including electrical distribution system, estimated to cost about $150,000. Proposed to arrange bond issue at early date. Ocean City Chamber of Commerce is active in project.

LA PORTE CITY, IOWA, has authorized bond issue of $100,000 for municipal power plant, and will have plans drawn at once. Bids will be asked early in the spring. G. E. Stebbnis, town clerk, in charge.

DENVER, COLO., plans electrification of waterworks in Capitol Hill district, with installation of pumping machinery and accessory equipment. Water Department, D. D. Gross, chief engineer, in charge.

TWO N. J. MUNICIPALITIES are considering construction of municipal power plants. At Elizabeth, Board of Works is making investigations and estimates and will report at early date. Teaneck proposes early surveys and estimates of cost; Karl D. Van Wagner, councilman, is active in the project.

GUMMED PRODUCTS CO., Troy, Ohio, has approved plans for power house in connection with expansion at paper products plant, with installation of boilers, pumping machinery, feedwater equipment and auxiliaries. Work will begin soon. Entire project will cost about $200,000. John Henri Deeken, Times-Star Bldg., Cincinnati, Ohio, architect.

MIAMI BEACH, FLA., has tentative plans for municipal power plant, estimated to cost about $2,000,000, with transmission and distributing lines. Proposed to arrange financing at early date. Morris N. Lipp, city engineer, in charge.

ALLIED SERVICE, INC., Memphis, Tenn., has plans for new ice-manufacturing plant on Bodley Ave., with initial capacity of about 30 tons per day. Bids soon. Cost close to $35,000. W. F. Wolbrecht, Jr., president.

PAWHUSKA, OKLA., has authorized extensions and improvements in municipal power plant, including installation of new 1,000-hp. diesel-generator unit and auxiliary equipment. City engineering department in charge.

KOPPITZ-MELCHERS BREWING CO., Detroit, Mich., recently organized, care of Mildner & Eisen, Hammond Bldg., city, architects, plans boiler plant at proposed new multi-story brewery at foot of Dubois Ave. Bids will be asked soon. Project will cost over $150,000. Company is disposing of stock issue to total about $600,000.

LEXINGTON, VA., is projecting plans for steam power plant in connection with extensions in water supply system and other municipal improvements. Cost estimated over $100,000. Dept. Public Works, H. B. Rice, supt., in charge.

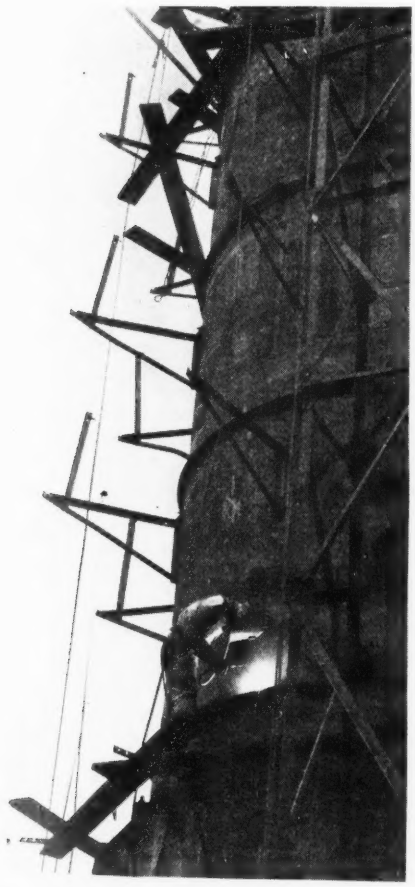
BOUNTIFUL, UTAH, has authorized bond issue of $106,000 for new municipal power plant, and will have plans drawn at once. S. Lloyd Riley, city recorder, in charge.

CHRISTIANSBURG, VA., is planning municipal power plant, with distribution system. Estimated cost $250,000. Financing will be arranged and engineer selected at early date.

SABINE VALLEY GASOLINE CO., Shreveport, La., H. R. Dickerson, president, plans series of pumping and booster plants along new welded steel 65-mi. pipeline from East Texas oil fields to proposed gasoline refining plant in Gregg County, Tex., on Sabine River. Pipeline will be built under direction of Apex Construction Co., Second National Bank Bldg., Houston, Tex. A power house, as well as main pumping plant, will be built at refinery. Entire project will cost about $500,000.

WICHITA FALLS, TEX., will have plans drawn at early date for new municipal power plant. City Council has approved an ordinance for a bond issue of $2,200,000, and financing will be arranged at once.

SUMNER AND SHENANDOAH, IOWA, will begin work soon on municipal electric light and power projects, and have awarded contracts for prime movers to Fairbanks, Morse & Co., Chicago, Ill. Sumner project will consist of station and distribution system, to cost close to $115,000; H. L. Cory Co., Baum Bldg., Omaha, Neb., consulting engineer. Work at Shenandoah will comprise addition, and will cost upward of $50,000; Allen T. Vagtborg, Inc., 205 West Wacker Drive, Chicago, consulting engineer.



TOWER "GROWS" 2¾ IN. IN SERVICE

This arc-welded bubble tower for production of finished asphalt at Maurer, N. J., will "grow" almost 3 in. taller when operated at 650 deg. First of its type to be built under the new vacuum code, it is 55 ft. high, 15 ft. in diameter, and of plates ¾ to ⅞ in. thick. Photo courtesy Lincoln Electric Co.

PUBLIC UTILITIES COMMITTEE, Worcester, Mass., has been instructed by City Council to make investigations and estimates of cost for a municipal power plant, and to report on findings and recommendations in March.

DOVER, OHIO, has plans under way for addition to municipal power plant, with installation of generator and accessory equipment. Cost about $330,000. Financing being arranged. William C. Kammerer & Associates, Sloan Bldg., Cleveland, Ohio, consulting engineers.

NORGE CORP., Detroit, Mich., has authorized immediate rebuilding of power house, including boiler and engine departments, at refrigerator manufacturing plant, Muskegon Heights, Mich., recently destroyed by fire. Loss about $50,000, with equipment. Strom Construction Co., Muskegon, has contract for new building.

PLACERVILLE FRUIT GROWERS' ASS'N., Placerville, Calif., is planning new precooling, cold storage and ice-manufacturing plant at local fruitpacking works, to cost about $230,000 with equipment.

WIS. VALLEY IMPROVEMENT ASSN., Wisconsin Rapids, Wis., George W. Mead, president, has plans maturing for hydro-electric plant on Wisconsin River, in connection with water supply project in vicinity of Knowlton, Wis. Large storage reservoir will be built to utilize water flow from Big and Little Eau Pleine Rivers. Cost about $5,000,000. Application has been made for permission.

NEW ROCHELLE, N. Y., is considering municipal power plant to cost about $3,600,000, including distributing lines. New Rochelle Public Utility Rate League, Francis Orifano, president, active in project, and will carry out financing.

U. S. ENGINEER HEADQUARTERS, Washington, D. C., Maj.-Gen. E. M. Markham, chief, is arranging list of 14 lock and dam construction projects on Mississippi River, recommended to be carried out during fiscal year 1935-36. Developments will include power plants, electrical control stations, electric-operated gates and accessories, gate-operating houses, electric light and power systems. Projects include Lock and Dam No. 3, Red Wing, Minn., estimated cost $2,000,000; Lock and Dam No. 7, LaCrosse, Wis., cost about $3,000,000; Lock and Dam No. 8, Genoa, Wis., $3,000,000; Lock and Dam No. 9, Lynxville, Wis., $3,000,000; Lock and Dam No. 11, Eagle Point, Wis., $3,000,000; Lock and Dam No. 12, Bellevue, Iowa, $3,000,000; Lock and Dam No. 13, Clinton, Iowa, $2,000,000; Lock and Dam No. 14, Le Claire, Iowa, $2,000,000; Lock and Dam No. 17, New Boston, Ill., $2,000,000; Lock and Dam No. 18, Burlington, Iowa, $3,000,000; Lock and Dam No. 21, Quincy, Ill., $3,000,000; Lock and Dam No. 23, Louisiana, Mo., $2,000,000; Lock and Dam No. 24, Hamburg, Ill., $2,000,000; and Lock and Dam No. 25, Cape au Gris, Mo., $2,000,000. Total projects aggregate $35,000,000 and it is proposed to arrange an appropriation in that amount.

NEW BULLETINS

Furnace Lining and Arches—McLeod & Henry Co., Troy, N. Y. Catalog 235, 32 pages, covers design installation and service advantages for modern boiler furnaces.

Floor Grating—Arrowhead Iron Works, 421 West 5th St., Kansas City, Mo. 16-page catalog, "Arrowhead Grating," describes steel grating suitable for power-plant floors and walkways, and other purposes.

Rubber Goods — B. F. Goodrich Co., Akron, Ohio. 23-page booklet catalogs variety of rubber goods, including belting, hose, packing.

Aftercoolers—Ingersoll-Rand Co., Phillipsburg, N. J. 12-page catalog, "Aftercoolers for Air or Gas," describes equipment, discusses applications.

Spray Equipment—Binks Mfg. Co., 3113 Carroll Ave., Chicago, Ill. 32-page, 2-color bulletin AD 114, covers spray-gun equipment.

Instrumeent Transformers — Allis-Chalmers Mfg. Co., Milwaukee, Wis. 36-page catalog No. 152 describes "Transformers for Instrument and Metering Service."

Flowmeter—American Meter Co., 60 East 42d St., New York. Bulletin describing "Metric Indicating Flowmeter," fits standard letter-size loose-leaf binder. The number is E-3.

Metal Spray — Metal Spray Co., 113 Llewellyn St., Los Angeles, Calif. Three bulletins, Nos. 323, 351, 500, discuss applications and equipment.

Boiler Feed Control—Northern Equipment Co., Erie, Pa. Folder No. 137 is illustrated paper by E. G. Grady, plant engineer, on "Operating Experience at Masonite With High-Pressure Boiler Feed Control."

Spray Cooling—Binks Mfg. Co., 3106 Carroll Ave., Chicago, Ill. 8-page bulletin describes indoor forced-draft spray-cooling towers. Another 8-page bulletin covers atmospheric spray cooling towers for air-conditioning and refrigeration.

Centrifugal Pumps—Allis-Chalmers Mfg. Co., Milwaukee, Wis. 48-page bulletin No. 1651 covers centrifugal pump types and applications.

Repair Cement—Smooth-On Mfg. Co., 570 Communipaw Ave., Jersey City, N. J. Booklet, "Home and Auto Repairs," describes applications of Smooth-On which should be of interest to power engineers.

Air Measurements—Julien Friez & Sons, Inc., Baltimore, Md. Bulletin describes air and air-conditioning instruments as follows: Bulletin K, air-conditioning products; Bulletin S, standard measuring and recording instruments; Bulletin L, thermometers; Bulletin M, "Red Top" thermo-regulators.

Flowmeters—Schutte-Koerting Co., 12th & Thompson Sts., Philadelphia, Pa. 26-page bulletin, 18-R, describes "Rotameters, for Measurement of Liquid and Gas Flow." Beautifully illustrated in three colors to show application of rotating visible float principle to fluid flow measurement.

Sectional Steel — Bethlehem Steel Co., Bethlehem, Pa. Booklet No. 78, "Bethlehem Light Sections," covers light section beams, joists, stanchions, to save weight and cost.

Electrical Devices—Struthers Dunn, Inc., 139 N. Juniper St., Philadelphia, Pa. Bulletin 292 describes briefly entire line of relays, timing devices, electric counters, thermostats, electric pots and ladles.

Compressors and Vacuum Pumps—Allis-Chalmers Mfg. Co., Milwaukee. Wis. Bulletin No. 2171 describes rotary air compressors and dry vacuum pumps for pressures up to 10 lb. gage and vacuums up to 18 in. of mercury.

Temperature Indication—General Electric Co., Schenectady, N. Y. Bulletin GEA-1075A (superseding GEA-1075) describes new temperature-indicating equipment for a.c. generators, motors and transformers.

Gas Engines—Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin, "Worthington Gas Engines, Vertical Four-Cycle, types BG, CG, DG and EG," describes these units.

Hydraulic Accumulators—Seamless Steel Equipment Corp., 39 Broadway, New York, N. Y. "Hydraulik Accumulators" describes compressed-air accumulators for use on hydraulic service.

NEW BULLETINS

(Further items on next left-hand page)

Air Filters—Coppus Engineering Corp., Worcester, Mass. Two new bulletins, the first a comparative product chart based on figures taken in test at University of California on oily impingement and dry-type filters, and, second, on leading makes of dry-type filters. The other bulletin, "Facts About Annis Air Filters," describes manufacture, assembly, operation and use.

Condenser Tubes—Scovill Mfg. Co., 4-page price list effective Oct. 23 on condenser and heat exchanger tubes.

Diesel Engines—Ingersoll-Rand Co., 11 Broadway, New York, N. Y. 20-page catalog discussing 4-cycle, single-acting, solid-injection stationary diesels with box-type housing, cylinder liners and overhead chain-driven camshaft, fully inclosed, automatically lubricated. Sizes 175 to 1,500 b.hp.

History of Coal—The Consolidation Coal Co., Inc., 30 Rockefeller Plaza, New York, N. Y. 100-page, carefully bound "History of Consolidation Coal Co., 1864-1934," describes story of company from Civil War times and covers seventy years of America's greatest industrial development. Excellent discussion of forces which shaped America.

Industrial Lubrication—Standard Oil Co. of New Jersey, Magazine, "Esso Oil-Ways," includes brief biography of Nicholas Otto, inventor of 4-stroke cycle engine; also considerable information on industrial lubrication. A monthly magazine.

Instruments — Foxboro Co., Foxboro, Mass. Attractive 8-page folder describing temperature, pressure, flow, humidity and liquid level recorders.

Paint — Bakelite Corp., River Road, Bound Brook, N. J. 24-page booklet, "Bakelite Synthetic Resins for Paints and Varnishes," gives history and properties of resinoids.

Power Factor—Esterline-Angus Co., Indianapolis, Ind. 4-page bulletin No. 934 discusses "Power, Power Factor and Profits," discussing a study of the plant of United-Carr Fastener Co., Cambridge, Mass.

Relays — Weston Electrical Instrument Corp., Newark, N. J. 12-page bulletin, "Weston Relays," describing comprehensive lines of sensitive, toggle, polarized, power and time delay relays.

Steel Length Multiples—Timken Steel & Tube Co., Canton, Ohio. Six sheets of tables punched for standard 3-ring binders, entitled "Multiples At a Glance," gives ten tables for steel users to tell at a glance either how long stock must be to furnish definite number of multiples or how many multiples can be cut from a given length of stock. Multiples up to 50 in number from 1 to 60 in. in length by sixty-fourths are included.

Switchgear—4-page GEA-1327A on indoor disconnecting switches with silver-line pressure contacts for 5,000-volt service, 400 to 5,000 amp. on insulating bases, 400 to 1,200 amp. on compound insulators; also 2-page GEA-1585A on high-voltage magnetic switches of the oil-immersed type for service under 2,200 to 6,000 volts; also 8-page GEA-1137B on indoor a.c. cubicle switchgear with manually or electrically operated breakers up to 15,000 volts and 2,000 amp.

Turbine Blading—International Nickel Co., Inc., 67 Wall St., New York, N. Y. Fall Edition, 1934, of "INCO," Vol. XII, No. 3, has article on page 7 "Higher Marine Speeds Call for Better Turbine Blading," giving comprehensive discussion.

Valve Reconditioning—Edward Valve & Mfg. Co., East Chicago, Ill. Regular monthly edition of "Valve Values" discusses reconditioning of valves and gives other information.

Water Analysis—W. H. & L. D. Betz, 235 West Wyoming Ave., Philadelphia, or 50 Church St., New York, N. Y. 18-page booklet, "Interpretation of Water Analysis," giving detailed discussion and explanation.

Welding Equipment—Linde Air Products Co., 30 East 42d St., New York, N. Y. Two new booklets. Revised edition of "Precautions and Safe Practices" discusses the subjects in relation to oxyacetylene welding and cutting. "Recommended Practices for Gas Cutting of Structural Steel" is a complete and authoritative treatment, which also sets up qualifications for predetermination of good workmanship.

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ala., Tuscumbia — Municipality soon takes bids municipal light and power system, incl. substation building with equipment and distribution lines. $130,000 allotted by P.W.A. project. Lide & Adler, Birmingham, engrs.

Calif., Crescent City—City Council completes application to Federal Power Comn. and State Division of Natural Resources for permit to construct hydro-electric plant at power dam site on south fork of Smith River, 15 mi. east of here. V. C. Finch, Stanford University, Palo Alto, engr.

Calif., El Centro — Imperial Irrigation Dist., E. T. Hughes, pres. Bd. Directors approved plan for $12,000,000 P.W.A. loan to finance construction of 5 hydro-electric power plants along All-American Canal. Engineers have recommended that application be made. Work involves 5 power plants $6,620,000, transmission line in Coachella Valley $3,667,000, expansion of stand-by plant now being constructed at Brawley $1,500,000.

Calif., Los Angeles — Los Angeles Bureau Power & Light, 207 South Bway., plans substation for installation of distribution facilities for bureau, on Maywood Ave. between Yosemite St. and Fairpark. $150,000. E. F. Scattergood, 207 South Bway., engrs. City Council approved project.

Calif., Napa — Municipality plans municipal electric power plant and distribution system or purchase of existing facilities and making additions and improvements to same. B. Sheer, Oakland, engr., will make report after Mar. 18.

Del., Seaford — Municipality voted $150,000 for electric power plant.

Ia., Waukon — City Council, F. B. Thorsen, city clk., has preliminary survey made by Young & Stanley, Inc., consult. engrs., Muscatine, indicating cost of construction, maintaining and operating a municipal light and power plant and distribution system. Project could be financed through general contractor agreeing to accept payments through earnings of plant. Further plans will be decided by City Council.

Md., Ocean City—Municipality plans electric and light power plant. $150,000. **Maturity indefinite.**

Mich., Birmingham—City making plans and estimates for municipal power plant. $75,000. J. W. Parry, city mgr.

Mich., Northport—City retained P. H. Beauvais & Associates, engrs., Manistee, to prepare plans and estimates for municipal electric light and power plant and distribution system. Est. about $100,000.

Mich., Northville—Ford Motor Co., Dearborn, hydro-electric power plant and small factory building for small automobile tools and equipment. Newburgh Rd., vicinity of here. Owner builds. Giffels & Vallet, 606 Marquette Bldg., Detroit, engrs. and archts.

Minn., Carlton—Village, c/o L. Scheidermayer, plans electric power plant. To exceed $30,000. **Maturity indefinite.**

Mo., Anderson — City plans hydro-electric plant, oil engine, 100 ft. dam. $50,000. A. C. Moore, P. O. Box 305, Joplin, engr.

N. Y., Auburn—City voted Feb. 14 to enact a local law authorizing construction of municipal power plant. Public referendum to be held April 18. $1,500,000.

N. Y., Avoca—Village, J. W. Kennedy, mayor, sketches municipal light and power plant. Plan to harness municipal water supply reservoir to provide power to drive turbines, also install auxiliary Diesel engines. To exceed $105,000. Engineer not appointed.

N. Y., Endicott — Village plans electrical general plant. $200,000. Will apply for federal funds. C. F. Hunt, village engr.

N. Y., Jamestown—Bureau P. Utilities, C. O. Johnson, Supt., City Hall, surveys completed by Peter Loftus, engr., c/o owner, for municipal light and power plant. Board plans to expend $474,405 for improvements, incl. new boilers and generating equipment at Steele St. power plant. $171,160 to be expended soon for new equipment to bring capacity of Steele St. plant to 12,100 kw., balance will be spent from time to time to improve Steele St. plant and other sub-stations.

N. Y., Norwich — City plans survey for power plant. P.W.A. funds to be applied for. Engineer not appointed.

N. Y., Rochester—Rochester Gas & Electric Corp., plans reconditioning and modernizing steam electric power plant, incl. high pressure boilers, turbines, etc. Est. about $1,000,000.

N. Y., Rockville Center — Dpt. P. Utilities, plans election to vote on application for P.W.A. loan and grant of $266,000 for which to add a diesel engine unit to municipal electric light and power plant.

N. C., Winston Salem — City plans electric power plant, $200,000. W. C. Olsen, 5 Exchange Pl., Raleigh, engr.

O., Athens—City Officials submitted proposition to State Planning Bd. for construction of municipal electric light plant, under new federal relief program. $350,000.

O., Chillicothe—City, W. S. Barrett, mayor, plans municipal combined light and water plant.

O., Grafton—Village, E. E. Arnold, pres. Bd. P. Affairs, report submitted by Hadlow & Elwell, archts. and engrs., 5005 Euclid Ave., Cleveland, for new power plant, substation and distribution lines. $45,000. P.W.A. project.

O., Lancaster — City plans municipal light plant. $175,000. Application made to P.W.A. for approval. A. Graf, city engr.

Okla., Hollis—City applied for P.W.A. loan to construct municipal light plant. $100,000.

Okla., Pawhuska—City Commissioners have approved new 1,000 hp. diesel engine for city light plant. $55,000. J. M. Buckley, city engr.

Pa., Liberty — Municipality plans diesel engine power plant. To exceed $30,000. M. H. Von Pagenhardt, 4000 Cathedral Ave. N. W., Wash., D. C., engr.

Pa., Warren—City, report submitted by Hadlow & Elwell, archts. and engrs., 5005 Euclid Ave., Cleveland, O., engineers, recommending light plant, diesel engine and distribution lines. $200,000. P.W.A. project.

R. I., Kingston—Rhode Island State College, Dr. R. G. Bressler, plans by Howe & Church, Turks Head Bldg., Providence, 2 story, 90x130 ft., power plant and remodeling Lippitt Hall. $140,000. P.W.A. project.

S. C., Fort Mill—Town plans power plant. $40,000. Will seek loan from P.W.A. to construct same.

Tex., Cooper—Municipality voted bonds to finance construction electric light and power plant. $100,000.

Tex., Welder—City, c/o J. Holloway, mayor, preliminary plans and surveys municipal light and power plant. City is at present discussing with Fairbanks-Morse Co. on proposition to build and install a complete plant. In fact, City will entertain a proposition from any company to build a system, is at present served by the Central Power & Light Co.

Tex., Sonora — City, filed application with State PWA Bd. for loan to finance construction of municipal electric light and power plant. $65,000. Engineer, c/o City Eng. Dpt.

Tex., San Angelo—City considering election to vote on bonds for electric light and power plant. Est. $900,000.

Va., Lynchburg—Appalachian Electric Power Co., Roanoke, plans electric substation, 15th St. Est. about $70,000.

Man., Winnipeg—Manitoba Power Comn. bids in March, constructing single phase 33,000 volt transmission line from Minnedosa to Neepawa and erect 225 kw. substation at Neepawa.

N. S., Bridgetown—Annapolis Basin Pulp & Power Co., Ltd., K. L. Crowell, mgr., preparing plans for pulp mill and electric power development at Paradise Lake.

Ont., Brantford—Proctor Packers Ltd. plans cold storage plant. $100,000.

Ont., Lindsay—City, W. R. Allen, clk., plans by city engineer power development at Fenelon Falls. $250,000.

Que., Quebec City—City Council ratifies plan for establishment of electric lighting plant, municipally owned, for house lighting and motive power purposes. **Maturity in spring.**

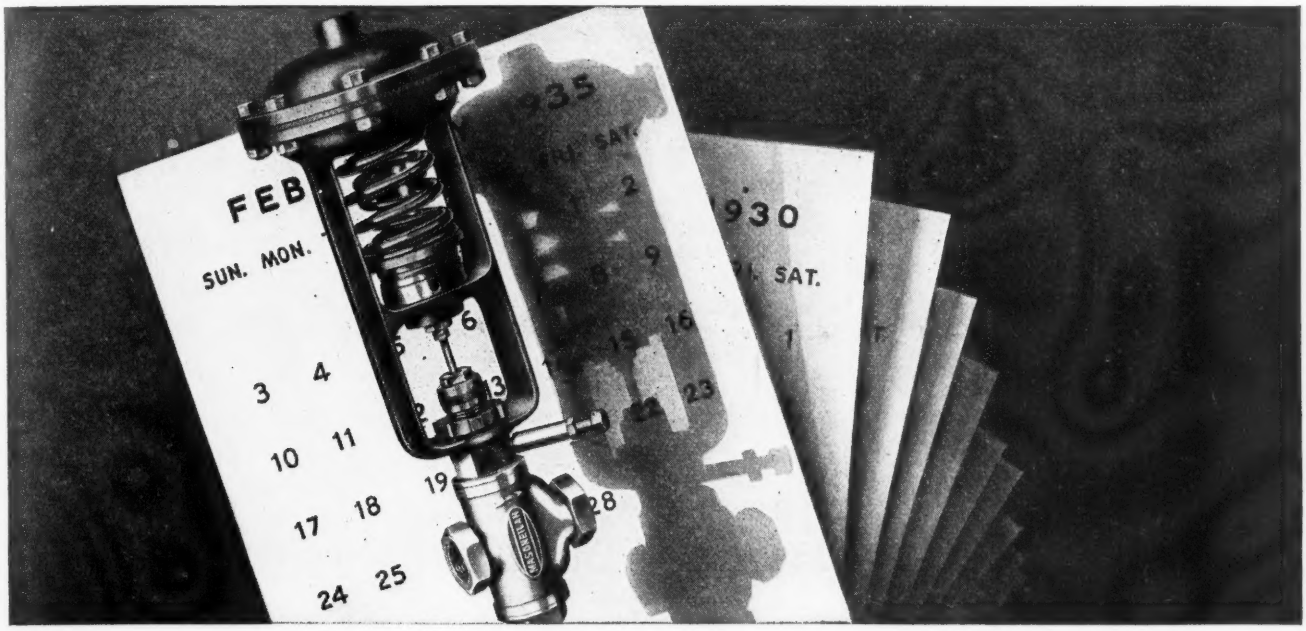
Sask., Prince Albert—Canadian Utilities Ltd. soon takes bids construction addition to power plant. $200,000.

Argentine, Buenos Aires—Apr. 23, by Argentine State Railways, supply power plant for Tafi Viejo Shops, consisting of four 500 kw. d.c. generators, driven by internal combustion engines with water cooling and circulation equipment, distribution and control switchboard, and plant to supply 500 k.v.a. at 6,600 volts, 50 cycle to an electric furnace.

Australia, Brisbane—City Electric Light Co., will receive bids until Apr. 15, 5,000 kw. turbo-alternator engine with direct coupled exciter closed air coupling, system, steam separator, surface condenser and auxiliary plant.

China — Chakiang Provincial Government, **Changechow**, erecting power plants at Nanking and Shishihyan, $3,700,000. Chinese Reconstruction Commission, Shanghai, engrs.

OUT OF 53 YEARS' EXPERIENCE



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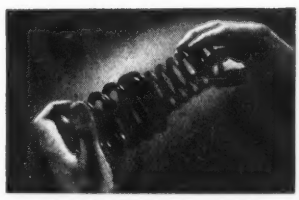
In the new Series 500, Mason-Neilan embodies the findings of a half-century's experience . . . presents a regulator for 1935's most exacting demands for more accurate pressure control.

At the right are three of the outstanding features which enable the Series 500 Mason Regulators to give you the improved pressure regulation you need. These features assure more sensitive and accurate control, preventing variations in processing and in the quality of your products. They assure *economy* . . . save steam, prevent shut-downs and repairs.

You can turn out a better product and use less steam by replacing older regulators with the more efficient Mason-Neilan Series 500's. Write for Bulletin 102-C. Mason-Neilan Regulator Company, 1190 Adams Street, Boston, Mass.



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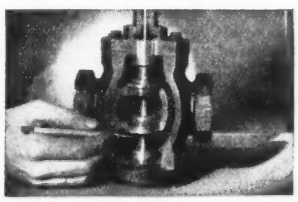
Increased flexibility — with improved characteristics — calculated and tested for each pressure range and valve size. New self-aligning construction to prevent side thrust, cocking of springs and misalignment of valve stem.

Ball Bearings

Non-corrosive stainless steel ball bearings reduce friction of valve stem and give smooth floating action. A ball thrust bearing carries the spring load, eliminates torque and makes adjustment easy and accurate.



Centroguide Valves

Reduce the erosive action of the steam across the valve seats, commonly known as wire drawing or steam cutting . . . reduce flow turbulence, increase body capacity and minimize repairs and maintenance costs.

MASON-NEILAN

PRESSURE • TEMPERATURE • FLOW CONTROL

MANUFACTURER'S BULLETINS

(Additional bulletins on page 168)

Optical Gaging—Adam Hilger, Ltd., 98 Kings Road, Camden Road, London, N.W. 1, England. 28-page booklet, "Optical Gauging and Inspection in Modern Engineering Practice." Shows tools and typical applications.

Lightning Arresters — General Electric Co., Schenectady, N. Y. 12-page Bulletin GEA-1304C on Thyrite, Form D, Lighting Arresters, Station Type; gives engineering data. Also 9-page Bulletin GEA-1993 on G-E inclosed indicating and drop-out fuse cutout, described recently in POWER.

Speed Reducers—D. O. James Mfg. Co., 1120 West Monroe St., Chicago, Ill. 12-page circular, "The World's Largest Post Office Completely Equipped with D. O. James Speed Reducers" describing Chicago installations.

Sheet Iron—Republic Steel Corp., Youngstown, Ohio. 65-page booklet, "Sheet Iron —A primer," tells story of sheet manufacture, discusses corrosion-resisting alloys. Fifth edition.

Forgings—Kropp Forge Co., 5301 W. Roosevelt Road, Chicago, Ill. 4-page bulletin, "Forging the Impossible," pictures striking examples of difficult jobs.

Steam Turbines—Elliott Co., Pittsburgh, Pa. 4-page bulletin describes Types AY and BY mechanical-drive turbines.

Valves—Edward Valve & Mfg. Co., Inc., East Chicago, Ind. Catalog No. 11-G4 describes forged-steel specialties, including gage and straight-through valves, strainers, relief valves, special valves for turbine oil lines, oil-well flow beans, small forged-steel stop-check valves.

Condensation Unit — American Steam Pump Co., Battle Creek, Mich. 4-page bulletin No. 426 describes (including capacity table) single and twin units, "Redi-Return," centrifugal, motor-driven, to handle condensate at 210 deg.

Steam Engines—Elliott Co., Pittsburgh, Pa. 32-page bulletin B-3 describes single-valve, 4-valve, Corliss-valve unaflow, poppet-valve unaflow. Fully illustrated, including cross-sections.

Feedwater Heater—Marshall Heater Co., 716-722 E. Monument Ave., Dayton, Ohio. Bulletin A describes open-type feedwater heater, purifier, and oil extractor combined.

Cranes—Cleveland Crane Eng. Co., Wickliffe, Ohio. 6-page bulletin illustrates tramrail and transfer bridges for industrial applications.

Tubing Weight Tables—Timken Steel & Tube Co., Canton, Ohio. 12-page "Master Weight Tables" tabulate in two colors weights of hot- and cold-finished tubing from $\frac{1}{16}$ in. up to $10\frac{3}{4}$ in., and from wall thickness 36 B.W.G. to $1\frac{5}{8}$ in. All dimensions given in both common fractions and decimal equivalents. Bulletin printed on letter-size bond punched for notebook and free from advertising.

Long-Distance Metering—The Bristol Co., Waterbury, Conn. Bulletin 424 covers equipment for telemetering pressure, liquid level, temperature, flow and motion with simple 2-wire circuits. Includes detailed technical information on construction and application.

Alloy Steel Boiler Plate—Lukens Steel Co., Coatesville, Pa. Bulletin, "Specification for Chrome-Manganese-Silicon Alloy Steel Boiler Plate," is reprint from A.S.M.E. Boiler Construction Code.

Pyrometers — Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa. Leaflet A-3410 describes small single and multiple pyrometers for diesel-engine exhaust temperatures and general industrial applications.

Idea Exchange—Standard Oil Co of Indiana, 910 S. Michigan Ave., Chicago, Ill. Company has set up bulletin service for exchange of technical ideas. Going to field salesmen, these bulletins contain ideas on lubrication applications from any source, including engineers.

Stokers—Whitty Mfg. Co., 216 High St., Boston, Mass. Three new bulletins for real estate, industrial and greenhouse users, describe horsepower range, operating methods.

Centrifugal Pumps — Worthington Pump & Machinery Corp., Harrison, N. J. 4-page bulletin describes single-stage volute pumps, Type L.

Induction Motors — Allis-Chalmers Mfg. Co., Milwaukee, Wis. Leaflet 2182 describes new steel-clad induction motor with protected winding, built up to 25-hp., 1,800 r.p.m.

Roofs—Johns-Manville, 22 East 40th St., New York, N. Y. Two bulletins, "3 Modern Developments," "What About Your Roofs?" discuss construction and maintenance of industrial and building roofs.

Research Institution—Battelle Memorial Institute, Columbus, Ohio. Beautifully illustrated booklet describes Institute's facilities for serving industry through research.

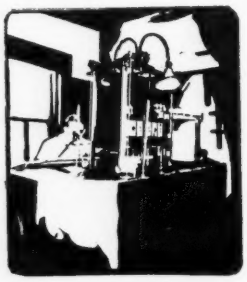
Rubber Goods—New York Belting & Packing Co., Passaic, N. J. Mechanical Rubber Goods Catalog gives much information about hose, belting, packing and miscellaneous mechanical rubber products. Tables show belt speeds, steam pressures and temperatures, carrying capacities and dimensions. Many practical formulas. Size, $8\frac{1}{2}$ x 11 in., 96 pages.

Coal Crusher—The Jeffrey Mfg. Co., Columbus, Ohio. Bulletin 598, 4 pages, describes "Flextooth" crusher for run-of-mine coal.

Compressor—Pennsylvania Pump & Compressor Co., Easton, Pa. Bulletin 157 gives detailed description of Class 3-AT single-stage, straight-line roller-bearing compressor.

Welded Ships — Lincoln Electric Co., Cleveland, Ohio. 4-page leaflet pictures wide variety of boats and ships constructed by "Shield-Arc" welding.

Renewable Gate Valves—Fairbanks Co., 397 Lafayette St., New York, N. Y. Bulletin, Fairbanks Renewable Gate Valves," describes renewable seats and method of application.



Outdoor Terminal Boxes—W. T. Henley's Telegraph Works Co., Ltd., G.P.O. Box No. 249, Holborn Viaduct, London, E.C. 1, England. Catalog UE 5 describes terminal boxes.

Grinding Wheels—Norton Co., Worcester, Mass. Bulletin, "Grinding Wheel Information and Selection." 59 pages, consists mainly of technical information and detailed commercial recommendations.

Arc Welder—Lincoln Electric Co., Cleveland, Ohio. One-sheet bulletin No. 308 gives specifications on a.c. motor-driven welders, types SAC-300-SAC-500.

Switchgear—Roller-Smith Co., 233 Broadway, New York. Catalog No. 8 devotes 24 pages to description of metal-clad switchgear, including control panel, open and inclosed dead front equipment, cubicles, metal-clad gear, switch houses and special equipment of many kinds.

Oil Fuse Cutouts—General Electric Co., Schenectady, N. Y. Bulletin GEA-2030, describes pole-type and subway-type G.E. oil fuse cutouts and lists applications.

Centrifugal Pumps—Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin, "Worthington Centrifugal Pumps, Single-Stage Volute, types LA and LC," describes these units, 4 pages.

Heat Insulation—Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh, Pa. Bulletin, "Insulate With Safety at any Temperature," describes brick for services up to 2,900 deg.

Lubricated Plug Valves — Merco-Nordstrom Valve Co., 400 N. Lexington Ave., Pittsburgh, Pa. 32-page bulletin describes lubricants for plug valves and explains use.

Perforated Metals—Manhattan Perforated Metal Co., Inc., 43-17 37th St., Long Island City, N. Y. Bulletin, "Perforated Metals," specifies perforation patterns and sizes of sheets furnished in brass, copper, Monel, steel and other metals.

Air Conditioning—Julien P. Friez & Sons, Inc., Baltimoree, Md. Literature covers automatic control, indication and recording of air condition.

Mechanical-Drive Turbines — General Electric Co., Schenectady, N. Y. Three bulletins describe mechanical-drive turbines, as follows: Bulletin GEA-1450B, Single-Stage Steam Turbines, 40 to 400 hp., Non-Condensing; Bulletin BEA-2044, Multistage Steam Turbines 100 to 2,00 hp., Condensing or Non-Condensing, Oil Relay Governor. Bulletin GEA-2024, Multistage Steam Turbines 100 to 2,000 hp., Condensing and Non-Condensing Steam-Extraction Multiport Valve Gear.

Metal-Clad Assembled Switchgear—General Electric Co., Schenectady, N. Y. 4-page bulletin GEK-86 describes metal-clad switchgear for installation in office building or industrial plants.

Cork Isolation—Cork Insulation Co., Inc., 155 East 44th St., New York. Bulletin 341 describes Corinco isolation corkboard for the control of noise and vibration.

Steel Insulation — American Flange & Mfg. Co., 26 Broadway, New York. Bulletin, "Testing Sheet Steel Insulation," reprints article showing results with steel for cold-room insulation.

Power Pumps — Worthington Pump & Machinery Corp., Harrison, N. J. Mimeographed sheets describe new type of totally-inclosed frame power pump, horizontal duplex.

Grab Bucket—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Release A-63888 describes new motor-driven grab bucket, capacities $\frac{1}{2}$ to 3 cu.yd., for handling coal and other material.

Brush Maintenance — Ohio Carbon Co., 12508 Berea Road, Lakewood, Ohio. Booklet, "The Brush Phase of Motor Maintenance," explains causes and cure of sparking, excessive wear of brushes, commutators and slip-rings.

Steam Trap—D. G. C. Trap & Valve Co., Inc., 366 Madison Ave., New York, N. Y. 4-page bulletin describes "Cryer Inverted Bucket Steam Trap."

CO_2 Recorder—Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Application Bulletin No. 23-101, 12 pages, places Bulletin No. 781, shows how Micromax a.c. potentiometers are used to record CO_2 of flue gases.

Combustion Control—Brooke Engineering Co., Inc., 175 W. Huntingdon St., Philadelphia, Pa. Bulletin No. 8, 8 pages, describes combustion control system for maintaining fuel oil ratio.

Pyrometer—The Pyrometer Instrument Co., 103 Lafayette St., New York. New illustrated catalog, "Pyro Immersion Pyrometer," is leaflet describing portable, self-contained pyrometer, with reading dial attached.

Motor Price Wheel—Louis-Allis Co., Milwaukee, Wis. Circular slide rule, printed in colors on heavy cardboard, tells frame sizes and list prices of 448 popular sizes and types of electric motors. Convenient and attractive gadget.

Vacuum Dial—Hoffman Specialty Co., Inc., Waterbury, Conn. Bulletin illustrates and describes radiator vacuum valve, also line of float and thermostatic traps and supply valves.

Relays—General Electric Co., Schenectady, N. Y. Bulletin GEA-1867, 12 pages, describes polyphase power-directional relays.

Gas Regulation — Chaplin-Fulton Mfg. Co., Pittsburgh, Pa. Catalog describes gas regulators, gas-fuel supply and steam-pressure control devices.